# Engineering Record

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## Cuban Opportunity

AS WAS prophesied in this journal last November the season just ended has proved one of unprecedented prosperity to the Cuban sugar plantations. As a result, the construction of new mills, with their miles of railways, bridges, and, often, wharves, is going on at a record rate. Money for the construction is plentiful and investors are eager. The only limiting factor is, seemingly, the inability of manufacturers to furnish the required machinery and materials within a reasonable period. With raw sugar selling at present top prices, time is at a premium. To supervise the construction ahead many engineers will be required, and in this feverish activity the American engineer—particularly the younger member of the profession—should find many opportunities; especially since a large part of the capital invested in Cuban sugar plantations comes from this country.

## Day Labor Again

AS this journal has pointed out before, if a city is to compete with contractors in doing work by day labor it must have as efficient a construction organization as is possessed by the average contractor. Moreover, a city cannot economically compete with contract work on construction requiring expensive machinery unless that construction is of such a nature that the city is engaged in it more or less continuously. Both these conditions have been fulfilled at Flint, Mich., the successful experiment of whose engineers in the day-labor field is described on page 767 of this issue. Students of the economic side of the day-labor question will also recognize that in laying pavements a city has an important advantage over contractors. The city is assured of its own work, and can handle as one large construction problem the paving of many streets from which no one contractor could expect to get anything but shorter and relatively more expensive contracts.

## Fire-Resistive Dwelling Houses

REALIZING the large annual losses sustained by thousands of home-owners through construction which tends to spread fires instead of retarding them, the committee on construction of buildings of the National Board of Fire Underwriters has issued a booklet of 115 pages on methods of increasing the fire-resistive qualities of dwellings. Builders everywhere, especially in localities outside the control of building ordinances (and by far the majority of ordinary dwellings are built in such localities), will find valuable information in this presentation of methods for making houses reasonably safe from fire. Particularly important, not only for builders but for owners and the general public, are the sections devoted to floor and roof construction; chimneys, flues, smokepipes and fireplaces; fire-stopping, and general precautions for fire protection. Generally-recognized dangers from such old offenders as shingle roofs, unlined chimneys, unprotected stairways and shafts are strikingly illustrated, and many simple and effective, while relatively inexpensive, devices in construction which retard the spread of fire are clearly explained. Every potential house-owner will find it profitable to become familiar with these building precautions, which may prevent loss of life as well as of property. Engineers, through their positions in building departments and their participation as plain citizens in civic associations, chambers of commerce and similar organizations, can let it be known that ordinary dwellings can readily be improved as to their fire-resistive qualities, and can direct interested parties to the proper source of information.

## Limitations in Flat-Slab Testing

INTERPRETATION of results in the testing of floor slabs in buildings can never be definitely conclusive. This fact should be kept in mind, especially during the current discussion of the results of the tests of buildings in Seattle. In this connection, the comments made by Professors A. N. Talbot and W. A. Slater in bulletin 84 of the Engineering Experiment Station, University of Illinois (just issued), describing tests of several types of flat-slab structures, are particularly valuable. It is stated that the unknown amount of the distribution of the resistance to adjacent unloaded parts of the structure (a point strongly emphasized by Mr. Hooker as a result of strain measurements in adjacent panels of the King County Court House test reported on another page) and the effect of the tensile strength of the concrete greatly modify the action of the structure. These factors, together with the physical conditions unfavorable to securing exactness, make definite and uniform quantitative results impossible. When, furthermore, the extreme variations in the actual construction of different buildings as a whole, together with errors in placing steel and effects of varying age and conditions of curing, are considered, it is evident that exact and definite general conclusions from such tests are impracticable.

Their recommendations of a series of tests on flat-slab structures, designed solely for the purpose of testing and systematically planned to bring out the fundamental differences between various types of design and the effect of varying certain elements, should be adopted, either by our national societies or by the U. S. Bureau of Standards, or by them jointly. Possibly financial assistance for such a program of tests could be obtained from those commercially interested. In any case, considering the wide diversity of practice in flat-slab design, such a scientific series of tests is a necessity, and would well repay the outlay.

## Timing Waterworks Purchases

WHILE purely technical considerations should claim a substantial part of the waterworks engineer's time, he should not be unmindful of the business side of his work. There are big opportunities for him to demonstrate his usefulness by looking ahead and timing his purchases of materials and supplies so as to secure the benefit of attractive prices. A case in point is that of a New Jersey town which is now making extensive alterations to its water-distribution system. When the improvements were under consideration many months ago the engineer in charge foresaw an advance in the price of pig lead, lead-service connections and brass fittings. Accordingly he purchased a large quantity of these materials when the prices were low. To-day, with his work under way, he gets considerable satisfaction from exhibiting his well-stocked storage yard, representing, at present prices, a big saving to the taxpayers. Of course, in the case of a private corporation there would be nothing remarkable in this instance of business acumen. In municipal administration, however, it is all too uncommon.

## Biaxial Loading Tests

MILD steel tubes tested by Prof. Albert J. Becker, as reported in bulletin 85 of the Engineering Experiment Station, University of Illinois, using combined axial loads and internal pressure and measuring external strains by a Berry strain gage, have given results for yield-point strength showing that two laws govern strength under such combined stresses, instead of one law, as hitherto assumed. The maximum-strain theory versus the maximum-shear theory, long a subject for experimentation, has apparently been definitely settled in the results attained by Professor Becker by a new and more satisfactory method of testing. Using Johnson's tangent method for fixing yield points, the only variable being the ratio of circumferential stress to axial stress, the yield-point strength is shown to vary according to the maximum-strain theory until the value of the shearing stress reaches the shearing yield point, after which the shearing stress controls according to the maximum-shear theory. For such ductile materials, therefore, the ratio of the shearing yield point to the tensile yield point for simple stress is important. Further experimentation along these lines should be actively pursued. After confirmatory results have been obtained, the effects upon the practical design of material under such combined stress conditions can be definitely formulated.

## Co-operation in the Collection of Municipal Data

DUE to the widespread character of our education most men above average intelligence are anxious to learn of the experiences of others when important tasks are in hand. True it is that they generally act without advising with others. As their matters grow in importance, however, they are more and more inclined to seek through books and magazines, technical, professional and trade organizations and direct inquiry information as to the solutions used by others under similar circumstances.

This applies as well to municipal undertakings as to other lines of activity. One finds cities, large and small, spending considerable time and energy in correspondence and travel in order to profit by the work of their neighbors, while careful search through printed matter is part of the regular procedure. If matters of recent development are under consideration, travel, if the observer be competent, will give the best results. It has the disadvantage of being costly. Moreover, as the competence of the observer decreases, its efficiency drops off at a rapid rate.

Realizing how great the need was for a data-collecting and distributing bureau the New York State Conference of Mayors last year established a bureau of municipal information, under the direction of a council of five mayors, elected by the conference. The council, in turn, elected as director and active head William P. Capes. The first report of the bureau was made to the seventh annual meeting of the conference in Syracuse last week.

An examination of the report to the Syracuse convention indicates that the director of the bureau fully understood not only the needs but also the methods by which the desired end could be attained. At the outset the bureau adopted three principles—a move which subsequent experience indicates to have been very wise. Not to advocate anything was the first principle; not to recommend any person, firm or thing, the second, and the third, to give as much information as possible on both sides of a controversial subject.

The first step was to establish relationship with the New York State Library, an arrangement furthered by the location of the bureau's headquarters at the state capital. The immense reservoir of information and the services of the staff of researchers maintained by the state are therefore at the disposal of the bureau. But the arrangement is truly co-operative. All printed matter received by the bureau, except the annual and special reports of the cities of the state, is sent to the library to be indexed and filed. By means of this relation the bureau is able to do work at a minimum cost, while the library is helped by the addition of the data and publications which the bureau collects. Furthermore, the bureau has established co-operative relationship with each municipal league in the thirty-five cities which now have them, and with many public and private agencies gathering and studying statistics and data about cities.

Effective use is made of a clipping service which supplies the bureau with all newspaper articles about municipal work in every city of the state. When one of these items indicates that a new charter, ordinance, budget or code has been adopted, or an amendment to any of these, the bureau requests immediately that a copy be furnished to it. In this way its information as to the latest municipal practice in the state is kept up-to-date.

But the clippings serve another end. They frequently enable the bureau to anticipate the needs of the municipalities it is designed to serve. When a clipping indicates, for example, that a city is contemplating the passage of an ordinance of a given type or is studying a certain situation the bureau makes it its business, without waiting for an application, to furnish the city with data on the subject.

One of the very interesting developments in the bureau's activities is its endeavor to make known to the cities of the state new ideas and plans that promise advantage to the communities, or that seem worth while trying. In pursuance of this idea reports regarding new and successful municipal activities have been secured, not only from cities in the state but from other towns, and sent to the mayors. Auxiliary activities consist in keeping the member cities informed as to proposed state legislation which would affect them in settling difficulties between state departments and particular cities, and in issuing a semi-monthly bulletin containing general municipal information, announcements of the activities of the conference and the bureau and a list of subjects researched during the previous two weeks.

In all, since its establishment somewhat over eight months ago, 148 reports have been prepared. These affect almost every phase of municipal information, and quite naturally a large number of them are on engineering subjects.

The cities of the state appreciate the service, for all cities in the state of the first and second classes contribute to the support of the bureau, and of those of the third class only eleven are not participating. Cities of the first class appropriate $500 annually; those of the second, $300, and those of the third, $150 each. That a great deal can be done at small cost is indicated by the budget of the bureau; in the first eight months the expenditures were only $4,789 and the total for the year are expected not to exceed $7,500.

The testimony of city officials in places both large and small indicates that having once availed themselves of the service they could not, without detriment to their administrations, be without it. The plan should certainly commend itself to bodies of municipal officials in other states. Such organizations exist in thirty-five states. Some of them are making attempts at work of this sort. Most of them, however, confine their activities to an annual convention. For greater effectiveness they might well plan to embark on the work which the New York State conference has so well begun.

## The Auto-Truck Highway—A New Factor in Back-Country Transportation

SINCE the advent of the railway there have been two modes, and only two, of developing new country—the highway and the railroad. Where the traffic was very small or the country difficult the highway was the only practicable solution of the transportation problem. With "easier" country and a goodly volume of traffic the railroads became possible, though how precarious was the venture in many cases the history of our pioneer roads plainly shows. There was no system of transportation intermediate between the highway and the railroad. The volume of traffic might have been greater than could be satisfactorily handled over the highway with the horse-drawn vehicles of former days, yet be insufficient to support a railroad. Nevertheless, the advantages of rail transportation—the greater speed and comfort, the lower ton-mile operating cost and the possibility of extensive developments coming in the wake of the railroad—spurred optimists to make investments. If the developments lagged behind what was hoped for, receiverships and forced sales with heavy losses ensued.

Is there not to-day some intermediary that will bridge the gap, in the matter of transportation economics, between the ordinary highway and the poorly built, possibly narrow-gage, railroad? Indications are that there is—that the "automobile highway," or better the "auto-truck highway." may fill the need. Such a transportation system could go up grades and around curves prohibitive for the steam railroad, or operate in units smaller than the railroad could operate profitably, and still it would utilize the economies of the motor truck as compared with the horse.

Let it not be understood that by this term is meant merely the placing of automobiles and trucks on existing highways, whether in well settled or sparsely settled sections. The term here signifies a road specially built for truck traffic and equipped with trucks and large-capacity passenger cars to furnish transportation between points not now connected, unless by ordinary wagon roads. The term should be considered to convey the idea, too, of a method of transporation used in lieu of a railroad either temporarily or permanently. In other words the auto-truck highway is here taken to be a transportation system—not merely a road or an independent stream of trucks—having a well defined place in transportation economics between the ordinary highway and the railroad.

Of course there may be various approximations of this idea. In this country there are many fleets of trucks operating over public roads, even when not adapted to their use, but this could not be considered an approximation of the "auto-truck highway." It would be an approximation if a municipal or governmental body spent considerable sums on the reconstruction, according to truck-road standards, of the sole highway connecting with the outer world. A still closer approximation would be afforded if a private company were given a franchise to rebuild the roads and allowed the exclusive commercial transportation rights over it, while not excluding cars and wagons used solely in the service of individuals.

The type of highway referred to, it should be noted, is not still in the realm of theory, though one may not be warranted in stating that it is beyond the experimental stage. Manifestly, in a development of this sort, so many conditions will enter that success to any particular enterprise cannot be unerringly predicted. In tropical countries, for example, road building is attended by unusual difficulties, while unforeseen problems may arise in connection with the transportation unit on account of climatic conditions. Nevertheless, the experience with both of these essential factors—the road and the truck—is such that there can be no permanent difficulty to prevent the ultimate development of the auto-truck highway. What transportation engineers will need is abundant information regarding the actual operation of such projects—the correct ton-mile costs, including both overhead and operating charges. There are data of this sort in existence. They are, however, the property of individuals and are closely guarded. When a given project is in hand, however, the truck manufacturers will give the data in their possession. In fact such is their confidence in the performance of their equipment that at least one of them has proposed to equip a highway and under a forfeiture of a bond to guarantee the minimum operating cost, including repairs, and also a maximum life of the unit.

A number of highways of the type referred to are in operation. In Bolivia, tin block is being hauled long distances over a plateau 14,000 ft. above sea level. In Central America a 90-mile truck road connects the capital of Honduras with the coast, while in Maine all the materials for a large construction job are going by trucks over a specially built highway 40 miles long. In one of the South American republics a road is projected to connect with the outer world an important city now lacking communication. A franchise exists for the building of a narrow-gage railroad, but remains inoperative because of the improbability of getting sufficient traffic to justify an $11,000,000 investment. On the other hand the auto-truck highway fully equipped would, it is estimated, cost only $4,000,000, and for this capitalization the prospective traffic, hauled by auto trucks, promises a handsome profit. Without a doubt the auto-truck highways referred to are but a pioneer of a considerable development. There must exist many cases where similar auto-truck projects offer the only hope for transportation speedier and cheaper than can be given by the ordinary highway.

Undoubtedly many problems will arise that are new. Certainly the conditions plainly indicate many respects in which the highway standard, for example, will have to be altered. Unusual attention will need to be given to drainage, to the structures, to the surfacing of the road itself. High speeds and heavy loads must be supported, and construction standards quite different from those considered sufficient under ordinary automobile traffic must be provided for. None of the conditions, however, so far as they now can be foreseen, are insuperable, and the problem, therefore, warrants the careful attention of those concerned with transportation matters.

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## The Daylight-Saving Problem

THE TIME has come when one must take the daylight-saving movement seriously. With its adoption in Germany, Austria-Hungary, Denmark, Holland and England it reaches international significance, especially since France, Norway and Sweden are very likely to follow the example of their neighbors. Some Canadian towns are already trying it, a few of our own cities are moving toward it and now the metropolis is discussing its advisability.

As a starting point in a fair discussion of the matter one must admit at once that people certainly are far from making the most of daylight. In summer the sun has been up an hour or two ere mankind begins to waken. The early rising propaganda, carried on chiefly by strenuous elderly folk who cannot sleep in the morning, has been a dead failure.

Yet there is little doubt that the early morning hours are hours of exceptional efficiency. The present daylight-saving scheme differs from the former efforts to promote early rising merely in its psychology. It proceeds on the plausible theory that mankind is a slave of the clock and will gladly arise an hour ahead of the usual time if the mendacious hands of his timepiece deceive him. Those who would feel themselves scandalously wronged if the "boss" called on them to report at seven-thirty after May 1, would turn up smiling if the clocks still pointed to eight-thirty by virtue of having been shoved forward an hour in the night. The experience already gathered in the countries which have adopted the plan seems to show that the psychological theory is right, for everywhere the change has been made it has been quite easy and simple, although not yet long tried.

Granted this, what special good is going to be accomplished? The hours of labor will be neither lengthened nor shortened. The only difference is that there would be more daylight left after the day's work is done, just as if one had moved into a higher latitude for the summer season. This is very agreeable on the whole, yet the actual saving in artificial light, one of the reasons, if not the chief, urged abroad, is rather illusory, since, in fact, people at the end of a warm day are more than likely to sit gladly in the growing dusk and only turn on the lights near bedtime. Places of amusement which depend on artificial light night or day will use it to exactly the same extent as before; public lighting will have to be used the same number of hours per day as now. On the whole, the saving in artificial light will be small, perhaps quite negligible.

From May 1 until September 1 the plan of setting the clock ahead an hour would work pretty well, but to rather dubious economy. If it could be tried in our country on a modest scale it would be a most interesting experiment, but unhappily it is necessary to work it over the whole country or not at all in order to avoid utterly hopeless confusion in time tables and the means of intercommunication generally.

Besides, it must be remembered that we are now working on a standard time system, established after some difficulties, which is based on belts 15 deg. of longitude wide, or one hour in time. The standard time for the belt is that of the central meridian 75 deg. west for Eastern time. Now noon is not a conventional but an astronomical fact—the passage of the mean sun over the meridian of the place. Hence when it is 12 m. Eastern time, true noon has passed by half an hour on the eastern border of the belt and will come half an hour later on the western border. Suppose the clocks in the belt are all shoved forward an hour. Then the variation of nominal time from sun time, instead of being half an hour each way, will be a half hour in error at one edge and an hour and a half at the other. And to have the clock time an hour and a half ahead is serious in the matter of sunrise as the days begin to shorten. In fact, unless the period of daylight-saving were considerably shortened over the present proposals the use of artificial light would gain at one end of the day only to lose at the other. The fact is that with standard time belts 15 deg. wide even the half-hour error has proved by no means negligible, and some places near the edges of the belts have retained local time even after more than thirty years.

Therefore, in this country with its four belts of standard time it is a rather serious business to put the clocks an hour ahead. It is far more likely to make trouble than in England, for instance, where the time is Greenwich throughout and the variation from sun time nowhere great. The logical method of daylight-saving is frankly to shift the customary business and working hours in summer without fooling with the clocks. Difference in hours of work between summer and winter is not unusual, and if carried out systematically would gain everything to be accomplished by "daylight-saving" without the inconveniences resulting from mixing up the time tables or great discrepancies between nominal and sun time.

Despite the good arguments to the contrary, however, it would not be surprising to find communities here and there putting their clocks forward. "Psychology" is stronger than logic, and the "other fellow," meaning chiefly the traveler, will probably get little consideration for his protest against the confusion.

# Pressed-Steel Floor Forms Left in Place on Two-Mile Bridge Eliminate Carpenters

### City Engineers on St. Louis Municipal Bridge, Which Is Being Completed by Day-Labor System, Develop Short Cuts in Building of Walls, Piers and Floors

LABOR scarcity and its high price have forced the builders of the approaches to the St. Louis municipal bridge to take as many short cuts and use as much labor-saving equipment as possible. Thin pressed-steel domes fitted snugly between the I-beam stringers for the 2-mile roadway are the forms to be left in place. Electrically welded mats of reinforcing bars save time in assembling small rods over the enormous area. Steel forms for the retaining walls and for the piers have reduced the carpenter force to a minimum.

For three years the three immense center spans over the main channel of the Mississippi River have stood unused while two bond issues providing funds for building the approaches and putting the bridge into commission were defeated by those who were opposed to the privilege that would result of entrance into the city without payment of the present "arbitrary" fee of $3 per car. The third issue was successful, but it provided that the work on the approaches should be done under city supervision by union labor—restricted to the citizenry of St. Louis. This required the installation of all the labor-saving schemes that the engineers could devise in order to bring the costs within the limits of the appropriation. Numerous jurisdictional labor strikes have added to the complications.

The work necessary to complete the bridge involves laying the floor slab over the whole roadway; building on the Illinois side 457 concrete pedestal piers; four open caisson piers 22 ft. square and 45 to 50 ft. deep and extending 40 ft. above low-water level; six pneumatic caisson piers required for truss spans over the Mobile & Ohio River Railroad Company, Southern Railway Company and East St. Louis Connecting Railway Company railroad tracks, and six pneumatic caisson piers for the first viaduct tower of the combined approach east of the main channel spans; 24,000 tons of structural steel; 40,000 cu. yd. of concrete in piers, pedestals, abutment and retaining walls aggregating 17,000 ft. in length; 30,000 sq. yd. of concrete floor slab for the creosoted wood block over the whole roadway, and 12,000 sq. yd. of concrete floor slab for new and old sidewalks.

A LAND CONNECTION WILL SOON END 3-YEARS' ISOLATION OF MUNICIPAL BRIDGE

Work on the approach substructure was started in the spring of 1915 and on June 1 was 60 per cent completed. Only the pile work was let by contract and this was finished on May 15, 1916.

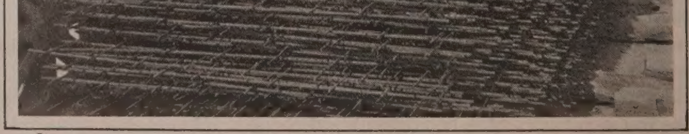
### Steel Forms for Tapered Piers

The typical pier has two octagonal bases and a square pedestal, varying from 8 to 18 ft. high. The lower base is 3 ft. thick and has an inscribed diameter of 12½ ft. The upper one is 2 ft. thick and has a diameter of 11½ ft., with four upturned rods embedded in it. The pedestals vary from 4 to 5 ft. 9 in. square at the top and have a batter of 1¼ in. per foot. The thirty Blaw forms used are erected and handled by structural iron workers. The variation in size was to be allowed for originally by wooden extensions at two corners. However, the construction engineers found that this did not work out well and various sizes of bent-steel corner pieces with angles to fit against the regular vertical angles on the original forms are used. These specials are applied to corners diagonally opposite each other only. On account of upward pressure of the concrete, due to the batter, four ¾-in. bolts are embedded in the base blocks to anchor the forms.

Two concrete mixers, a ½-yd. Smith and 2/3-yd. Ransome, are building the piers. One of them is served by an Orton & Steinbrenner locomotive crane and the other by a derrick car.

Spur tracks were laid to all parts of the work at one side of the line of piers to bring the concrete materials to the mixers and for handling the steel work with two Industrial cranes to the erectors. Usually the aggregate is unloaded to the ground by the locomotive crane and is then wheeled to the mixer-charging hopper, which is provided with a track extending to the ground

TIPPING BUCKETS ARE MOUNTED ON LORRY CARS



SIDEWALK MATS COME IN 16-FOOT LENGTHS

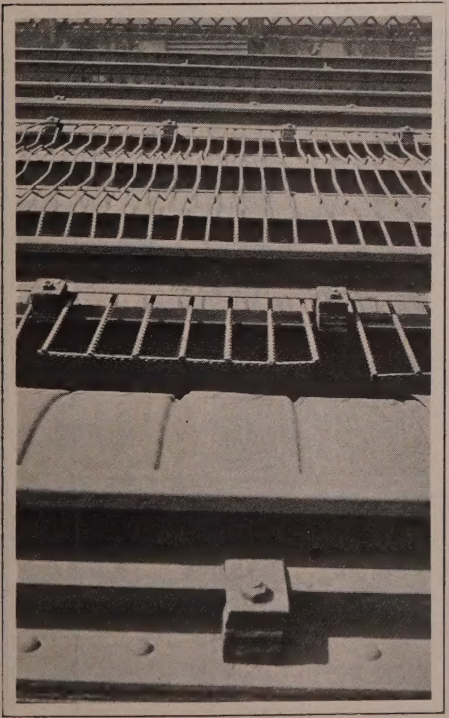
surface. Cement is stored on the mixer car. The crane raises the concrete in bottom-dump buckets to the top of the pedestal forms, but in some cases where the distance to the far line of piers is too great for the boom a wood chute is used to convey the concrete from a platform on the nearest pier.

### Erect Wall Forms at Low Cost

For building the walls a ¾-yd. Ransome mixer is mounted on a flat car at one end of which is a 50-ft. Lakewood tower resting on two 12 x 12-in. timbers cantilevered out from the end of the car, but provided with hinged struts to give stability during operation. The charger drops to the ground level as with the other outfits, but is fed by three 1-yd. Koppel dump cars running on a narrow-gage track to standard-gage cars, which are brought in only as fast as the material is used. Three 1-yd. hoppers, one on the sand and two on the stone cars, hung to the side of the cars, facilitate the operation.

Standard Hydraulic Pressed Steel Company wall forms are being used on the retaining walls and the abutment on the railway approach. Carpenters and laborers are putting these forms in place and, with the union carpenters' scale of 62½ cents per hour and the union laborers' scale of 35 cents per hour, the unit cost of building forms for the walls has been so much reduced that a large saving has been made over the use of wooden forms, such as were used on the retaining walls and abutment on the highway approach.

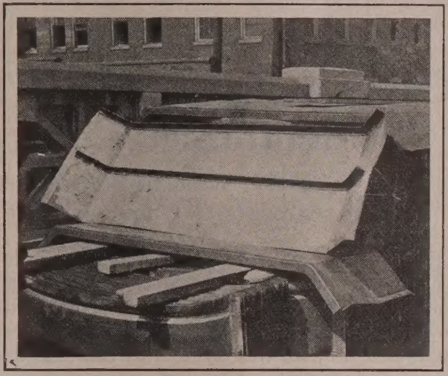
The walls vary in height from 8 to 25 ft., and enough ribs are supplied so that they may be left in place and the plates used on succeeding sections. In this way the plates can be taken out in 12 to 16 hours and still leave sufficient support for the green concrete by the ribs, which are tied together and support the wall until the concrete has thoroughly set. The ribs are taken out the second day and the operation is repeated. A certain capacity is guaranteed by the manufacturer and enough forms, ribs, plates and wedges are supplied to maintain this capacity. The engineers for the city state that the forms have worked out satisfactorily in every respect.



MATS ARE PUSHED UNDER INNER RAIL

### Forms for Floor Slabs Stay In

Specially designed thin pressed-steel domes set between the I-beam stringers and left there solved the problem of forms for the enormous floor-slab area. Wood forms of any kind would have to be suspended and a special falsework built to get them out. No underhung traveler was practical on account of the numerous cross bracing and towers on the approaches. The steel domes are pressed from 22-gage steel sheets laying 22 in. wide. They have two deep longitudinal corrugations to stiffen them and are guaranteed to support 90 lb. per square foot. The rise from the flat portion resting on the lower I-beam flange is 12⅞ in., with a curve nearly an ellipse made up of a short and a long radius curve. A man's weight deforms them somewhat, but he does not go through. When the reinforcing is in place the weight of the concrete is distributed sufficiently to prevent any deformation.



SPOT-WELDED ANGLES STIFFEN SIDEWALK FORMS

Note the small space taken up by the corrugated forms in the power pile.

There are two street-car tracks in the roadway and a sidewalk on each side. The stringer spacing requires different lengths of domes—three, 4 ft. 6½ in. long, for the devil strip; one each, 4 ft. 11⅛ in. for the tracks; one each, 3½ ft., for spaces between outer rails and curb, and one each, 5 ft 9 in., for the sidewalks. For the last named the space was too great for the corrugation to answer and two pressed-steel angles, ¾ x 1½ x ⅛ in., are spot-welded to reinforce the sheet, which is flat on top and has the ends bent down at an angle of 45 deg. to meet the lower I-beam flanges. In the central portion the welds were spotted about 4 in. apart and on the bent portion about 2 in. Six structural steel men have laid as high as 3000 sq. ft. of the domes in 8 hours.

### Steel Mats Reduce Laying Cost

The enormous area over which to lay reinforcement in the 9802-ft. length of the bridge presented another problem, since it was necessary to pay the skilled labor rates. It was impossible to change the design and use small arches, as the steel work had been figured for a reinforced slab and not to take any side thrust.

Electrically welded mats made up of seven ½-in. deformed bars spaced on 4-in. centers are used for the transverse reinforcing, and American Steel & Wire Company woven wire of special width and section for the longitudinal reinforcing. The welded mats, furnished by the Electric Welding Company, are spot-welded only at the ends to a ⅜-in. bar. At three places in the mats, 16 ft. 8 in. long, are Efficiency bar spacers which rest on the top of the domes. The long mats for the devil strip are pushed under the inner rails between the rail chairs and extend 18 in. into the gage space. Short mats extend from the curb under the rail for 18 in. and loose bars are lapped over the ends of the two mats for the slab in the gage space, both support and spacing being provided. The central mats could not be made long enough to extend under both rails of the same track because the rail chairs are not opposite each other. For the sidewalks the mats are made up with wire clips to secure the bars. The ⅜-in. bars are spaced on 6-in. centers transversely, and the ¼-in. bars in 16-ft. lengths are spaced on 9-in. centers longitudinally. The distribution and placing of the steel by the structural iron workers at 67½ cents per hour have been done at a remarkably low figure.

### Mine Locomotive Distributes Floor Materials

For handling the concrete over such a long stretch advantage is taken of the street railway tracks already laid. The west approach was completed originally and a concrete plant has been erected on an elevated platform at the point of diversion between the roadway and railroad. Storage space for 200 yd. of stone and 100 yd. of sand is provided on the ground below the trestle so that bottom-dump railroad cars can discharge directly into the bins. Two Link-Belt conveyors elevate the materials to the respective sand and stone bins of 4 and 8-yd. capacity over the ¾-yd. Ransome mixer. There is little space for a cement storage house, so that demurrage is charged off to that account. A platform holding 150 bags only for temporary supply is all that can be obtained. Cement is handled directly from the cars to the platform, where enough for a batch is emptied from the sacks into a narrow-gage car

MOUNTED MIXER IS ATTENDED BY CRANE

pulled up an incline to the mixer hopper.

For distributing the forms, reinforcing steel and the concrete two 5-ton standard-gage Whitcomb gasoline mine engines are provided, having a drawbar pull of 2000 lb. They were bought to start a load of 7½ tons on a 4-per cent grade and to attain a speed of 8 miles per hour. This will deliver the concrete at the farthest point in about 10 minutes. A temporary crossover permits the use of both tracks for distribution of concrete forms and reinforcing.

On account of the standard gage it was impossible to buy standard equipment in concrete dump cars. Eight Fairbanks-Morse hand-push cars used by section men were purchased and on six of them were mounted 1-yd. Koppel dump buckets. The buckets are on a swivel, so that the concrete can be dumped to each side and into the track space. With this outfit about 100 cu. yd. per day, equivalent to 100 lin. ft., can be placed with ten men.

The completion of the bridge is under the direct charge of Clinton H. Fisk, chief engineer of the Board of Public Service, of which E. B. Kinsey is president. W. S. Collar is superintendent of the bridge construction work. Brenneke & Fay are resident engineers and Boller & Hodge are the consulting engineers.

## Baltimore & Ohio Adds Second Dynamometer to Car

### Diaphragm-Type Instrument Indicates Both Pulling and Buffing Forces, and Is Sensitive to Small Variations

A NEW diaphragm-type dynamometer, arranged to indicate both pulling and buffing forces, has been added to the equipment of dynamometer car 930 of the Baltimore & Ohio Railroad, which was put in service three years ago. The new dynamometer has a capacity of 1,000,000 lb. in buff and 250,000 lb. in pull, the corresponding fluid pressures being 2000 and 1000 lb. per square inch respectively. The dynamometer has proved to be both accurate and sensitive to small variations in drawbar pull.

As originally built the car was 50 ft. 9 in. long over end sills, with a platform at one end only. At the opposite end was a direct pull cylinder type dynamometer mounted below the car floor, together with a recording table. In the center of the car were two staterooms, toilets and a kitchen, while at the platform end was a dining room. The dynamometer had a capacity of 200,000 lb. It has been entirely satisfactory for the purpose for which it was intended, but in order to get more precise readings the second, more delicately adjusted, machine has been installed at the platform end, under the dining table, as was originally planned. At the same time the platform has been inclosed and the space added to the dining room.

The lever of the new dynamometer, which is direct connected to the coupler, has the ratio of the arms so arranged in relation to the area of the diaphragm dynamometer plunger that for equal tension on the drawbars at either end of the car the fluid pressure in the two dynamometers is equal. The pressure pipes from the pull chambers of the two dynamometers are connected to the same indicator cylinder on the recording machine, so that the drawbar-pull record to a uniform scale may be obtained from either dynamometer.

The cylindrical pistons, which have a clearance of 1/64 in., are supported on knife edges and backed up with a reinforced lug on which the knife edges of the lever rest, thus giving accurate adjustments and enabling the instrument to register very slight pulls and buffs.

A half mixture of glycerine and alcohol is the liquid used in the new dynamometer, instead of the red engine oil used in the old one. An electric bell in the operating room warns the operator in case the liquid becomes so low that the lever travels more than ¼ in. off center.

The piping is cross connected, so that the pull on the new dynamometer can also be taken on the buff cylinder pen on the table, should occasion require, while the pull of the new dynamometer can be shown on the gage of the old, thus making the arrangement flexible and affording a check of one machine against the other.

## Compares Results of Tests on Three Types of Reinforced-Concrete Building Floors

### D. E. Hooker Reports Extensometer Measurements Showing Relatively High Strength for Joist-and-Tile as Compared with Flat-Slab Floors

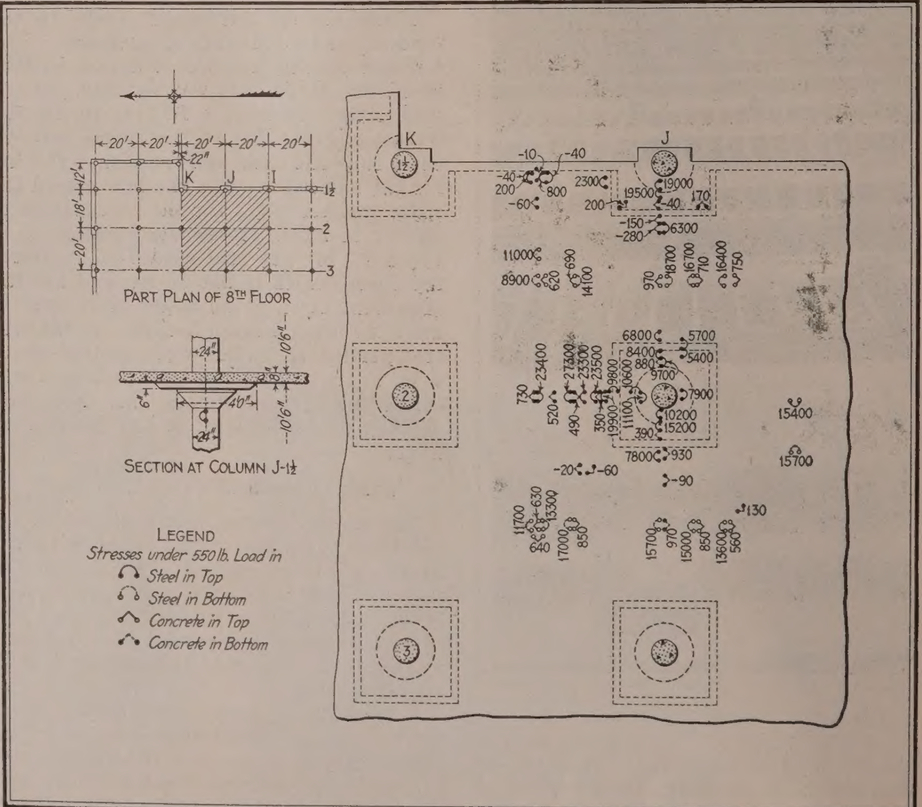
RESULTS of load tests and stress determination by extensometer readings on the floors of three types of reinforced-concrete building floors—the three-way system and the two-way system of flat-slab design and a hollow-tile and joist design—are cited by D. E. Hooker, assistant superintendent of buildings for the city of Seattle, in a paper published recently in the *Proceedings* of the Pacific Northwest Society of Engineers. The high stresses obtained for the three-way system in the Bell Street Warehouse, Seattle, were published in the Engineering Record of May 13, page 647. It is brought out in the discussion by the designer of this building, Captain A. O. Powell, that possible contributing causes for these high stresses are the uncured condition of the concrete and the misplacement of the reinforcing steel over column 80, the inner ring rod averaging 3 in. too low. See letters in this issue, page 778.

Included in the following abstract of the paper by Mr. Hooker describing the tests of the Sears-Roebuck Building and the King County court house in Seattle is a table showing the relative deformation of the three buildings at corresponding points which strikingly illustrates the differences in stresses under loads similarly related to the design loads.

### SEARS-ROEBUCK BUILDING

The Sears-Roebuck Building, nine stories high and occupying a tract 240 x 330 ft., has the largest floor area of any building in Seattle, and probably in the Northwest. It was designed by the Condron Company, of Chicago, and follows rather closely the standard Akme two-way flat-ceiling design of that company, except that the depressed panels at columns are 0.4 instead of 0.25 of the span.

The test area selected consisted of four contiguous panels near the northwest corner of the eighth floor, two interior panels 20 ft. square and two wall panels 18 x 20 ft. These slabs were poured April 17, 1915, and the test load was placed June 9, so that the concrete was about 52 days old, compared with 113 days for the Bell Street



STRESSES IN STEEL AND CONCRETE AT MAXIMUM LOAD—SEARS-ROEBUCK BUILDING

Warehouse test. The test load, consisting of piles of brick, was applied in three increments, twenty-four hours apart, the successive loads being 201, 402 and 550 lb. total per square foot. The last load plus the 100-lb. dead load brought the total live and dead load up to just twice the design load of 325 lb.; that is, 200 lb. live load plus 125 lb. dead load, including the cinder fill and wood-floor finish.

### RESULTS OF TEST

Using the same moduli of elasticity for steel and concrete as used for the Bell Street building, 29,000,000 and 2,500,000 lb. respectively, the stresses shown in an accompanying drawing were obtained from the measured strains. The greatest steel stress of 27,300 lb. per square inch, was obtained in a rod at the top of the slab over the main band between columns J2 and K2. These stresses were produced by the maximum load, equivalent to 1.7 times the design load.

In general the steel and concrete stresses are relatively small. The stresses for the various critical sections are fairly uniform, except in the secondary band running east and west where it passed up over the main band between columns J2 and K2. These stresses are relatively high, as above noted.

The stresses obtained at two gage lines on column J1½ demonstrated the remarkable effect of such eccentric loading on the wall column. Before the full load was applied sufficient tension developed in the outside of the column to crack the concrete in several places, including a crack between the gage points which nullified future readings. This bending effect for wall columns, Mr. Hooker pointed out, should always be taken into consideration in flat-slab design.

The maximum deflection was 0.48 in., practically the same for the centers of three panels. At some points of small deflection the recovery was 100 per cent, but in others of greater deflection it was as low as 54 per cent. However, the recovery readings were taken only a few hours after the load had been removed, and it is probable that the ultimate recovery was much greater, if not complete.

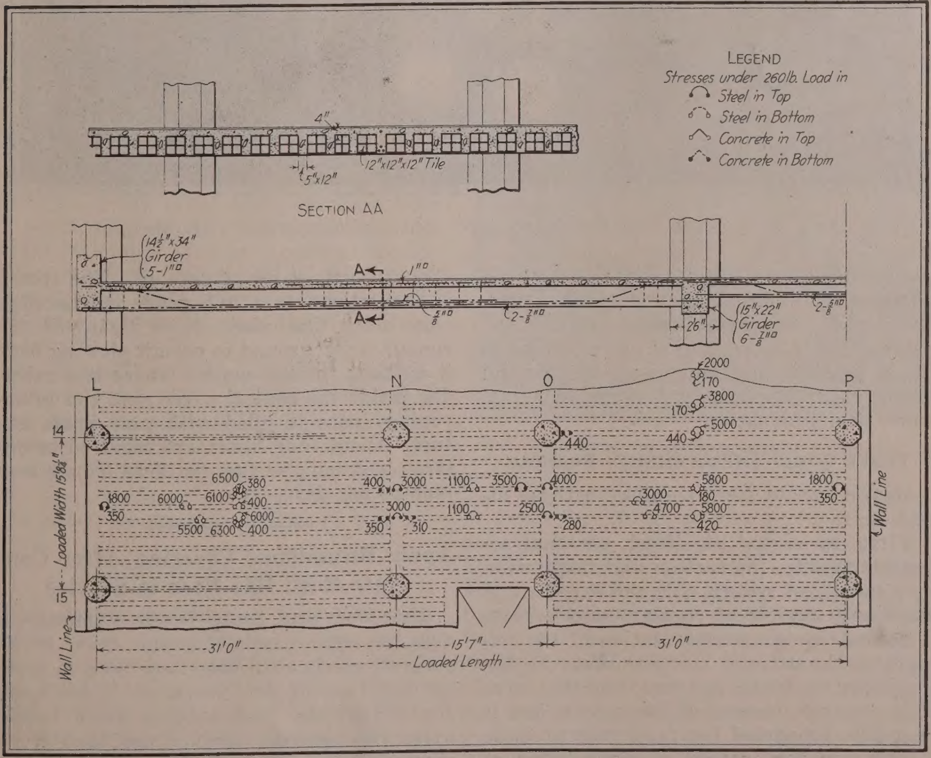
### KING COUNTY COURT HOUSE

The floors of the King County court house are of reinforced concrete with 12 x 12-in. terra-cotta tile forming the joists, as shown by an accompanying drawing. The design was taken exception to by the building department because there was too much steel in the joists to give adequate bond and permit puddling of the concrete (in fact, difficulties in placing concrete were met, and large voids in the bottom of the joists did occur in the construction afterward) and because it was feared that there would be excessive deflection in the long 31-ft. side spans, which were so shallow as to require compressive reinforcement. Furthermore, a comparatively small amount of steel was placed over the supports, and the three adjacent panels were designed as non-continuous beams. The contractor was therefore required to make a load test of a typical portion of the floor.

A test area one panel (15 ft. 8¼ in.) wide extending from wall to wall over the three panels shown on the fourth floor was selected. Deformations in steel and concrete were measured. The slab was poured Feb. 17, 1915, and tested June 25, at the age of 128 days, the whole area being loaded by cement in sacks in four increments—65, 130, 190 and 260 lb. total per square foot. This floor was designed for a live load of 75 lb. per square foot; the final load amounted to 1.2 times the design dead and live load of 215 lb.

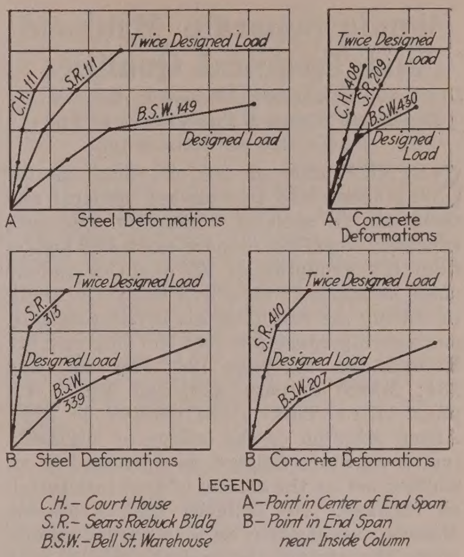
### RESULTS OF TEST

Remarkably small deflections and stresses were found. The maximum deflection was 0.3 in. at the center of one 31-ft. span (only 1/1240 of the span length). The greatest observed stress was about 6000 lb. per square inch in the steel and 450 lb. per square inch in the concrete under the maximum load. Over the interior girders the stresses were very low, as noted in an accompanying plan view.



STRESSES IN STEEL AND CONCRETE AT MAXIMUM LOAD—KING COUNTY COURT HOUSE

[These approximate stresses were computed from the strain diagrams of the Engineering Record—EDITOR.]



COMPARISON OF DEFORMATIONS IN THREE TYPES OF BUILDINGS

[The strains under maximum load have been transformed into approximate stresses by the same moduli as for the other cases, using the small-scale diagrams.—EDITOR.]

One fact stands out distinctly, Mr. Hooker pointed out. Strain measurements in adjacent panels showed considerable stress, and investigation of this lateral distribution of the load showed that the maximum steel stresses would probably have been about 9000 lb. per square inch and the concrete stresses about 600 lb. per square inch if this distribution had not occurred. In other words, the stresses were reduced about one-third by the assistance of adjacent unloaded panels.

### COMPARISON OF THREE TYPES

On an accompanying diagram is shown a comparison of the deformations at two gage lines selected as nearly as possible in the same relative positions in the different slabs. Each curve has been extended as a dotted line to the point of no load in order to form a proper comparison. The scales are varied to give the results in terms of design load.

The assistance of H. E. Fowler, of the Seattle Building Department, in helping to plan the tests, in taking readings and working up the computations, and appreciation of the kindness of Professors Fuller and More of the University of Washington in lending their instruments for these two tests is acknowledged by Mr. Hooker, who conducted them for this department.

## Valuable Potash May Be Found By Casual Drillers

Drilling contractors in regions where salt beds occur are liable at any time to discover deposits of potash, which is very valuable, according to the U. S. Geological Survey. So far potash has only been found in the United States at Searles Lake, Cal. The foreign supply of potash for this country has been practically cut off by the war, and the price of the salts has risen from $40 to $400 per ton. The potash beds of Germany and Spain were laid down in formations that include beds of salt, gypsum, anhydrite and such minerals, and it is unreasonable to suppose that potash does not occur in many similar formations in this country.

## Should Separate Manhood and Technical Qualities

**Dean Anson Marston, Discussing Engineering Education, Suggests Two Classes of Tests, Each Rated on Basis of 100**

SEPARATION of the qualifications for engineers into two classes, general and technical, in each of which 100 per cent represents perfect, is more exact and logical than the grouping of all qualities in one class, as has been done by Prof. C. R. Mann in stating the results of his investigation of engineering education (see the Engineering Record, Jan. 22, page 126; Jan. 29, page 134; March 4, page 329, and March 11, page 342). This is the opinion of Dean Anson Marston of the college of engineering, Iowa State College, as expressed in an address before the alumni of that institution at Chicago. He believes that Professor Mann's classification leads to absurd results when the attempt is made to use it as a guide in selecting men to fill engineering positions.

Dean Marston suggested that the institutions can improve engineering education by employing instructors with practical experience and ability to inspire the students professionally and culturally, by putting the colleges on a schedule comparable to business life and by requiring one or more years of engineering work between the sophomore and junior years.

The following summary gives the chief ideas brought out by Dean Marston:

### MODERN EDUCATIONAL PROBLEM

The present problem in engineering education is how to educate our engineers better in the fundamentals of successful manhood without sacrificing the quality of their technical education. Neither of these can be sacrificed for the other. The engineer must pass a double test, and not fail in either. The investigation by Prof. C. R. Mann, based on the fundamental idea that engineers should themselves define the kind of graduates they desire from the colleges, has led to a proposed score card in which values are assigned on the scale of 100 to each of six qualifications, of which 87 per cent are general, and only 13 per cent technical.

On account of failure to recognize that there are two separate essential sets of qualifications of an engineer, the proposed score card leads to absurd results when used as an actual guide in the selection of the best men to fill engineering positions. In actual application (shown by a table comparing three engineers with three business men rated according to Professor Mann's percentages) any first-class business man would receive preference for appointment to engineering positions over any engineer of merely fair general qualifications, no matter how high the engineer's technical skill.

### DOUBLE TEST NECESSARY

In reality there should be a double test for the engineer. First, the engineer should have satisfactory engineering skill; second, he should also have satisfactory fundamental manhood qualifications. Every criterion for testing engineers should have a separate detailed technical requirement which might include the following items: (1) Knowledge of the sciences underlying engineering, (2) knowledge of engineering, (3) engineering experience, (4) commercial training, (5) professional standing, including membership in engineering societies, contributions to engineering literature and professional honors.

The fundamental manhood qualifications should include: (1) character, including integrity, responsibility, resourcefulness and initiative; (2) health, including present health and freedom from injurious habits and from inherited weaknesses; (3) judgment, including common sense, scientific attitude and perspective; (4) efficiency, including thoroughness, accuracy, industry and discipline; (5) understanding of men and executive ability; (6) temperament, including evenness of temper, sympathy with others and ability to make friends without yielding principles; (7) culture and general education. No person should be ranked as an engineer who does not possess the above qualifications in a satisfactory degree, and this requirement should be separate from, and in addition to, satisfactory technical qualifications.

The engineering schools may properly be held accountable for the thoroughness of the instruction in mathematics and the other sciences underlying engineering; in English, including public speaking; in political economy; in commercial subjects, and in technical subjects. The development of the qualities of understanding of men, executive ability, resourcefulness, initiative and perspective is to be carried on in college as far as possible, but their most effective and extensive development will occur in actual work after graduation.

### THREE GREAT IMPROVEMENTS POSSIBLE

Improvements seem possible in three directions:

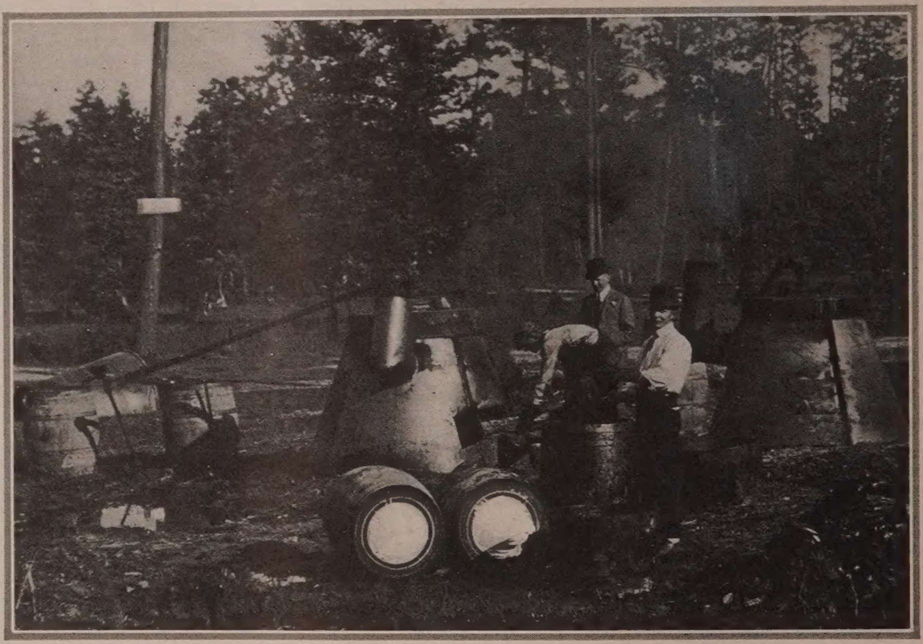
First, by organized, direct, personal acquaintanceship, instruction and inspiration by a faculty of strong, able and experienced engineers, outside of regular class lessons.

Second, by the reorganization of the colleges on the basis of business life. An engineering professor has three months' vacation per year, instead of two weeks, and is regularly scheduled for from two to three classes per day instead of eight hours of regular work. College students are not held to the strict accountability to which men and women in actual life are subjected. We ought to inquire seriously into the question of the possibility and advisability of reorganizing college work on a business basis, with 48 weeks of school per year. Daily schedules should be provided for faculty and students.

Third, by requiring one year or more of actual engineering work outside of college immediately following the sophomore year. Nothing will do more to make men of students than to set them to work with men under the strict discipline of actual business regulations.

## Timber Owners Make Stumps Pay

"UTILIZING the squeal" has long been the standard joke around a stockyards. Stumps in a timber country are not usually considered an asset, but Eastman, Gardiner & Company of Laurel, Miss., owners of much long leaf pine timber land, have found a way to distill various pine oils direct from the stump. From an ordinary good-sized stump about 25 gal. of distillate are obtained by the hood-shaped apparatus shown in the accompanying photograph. After removing the water there remain about 17 gal. of heavy pine oil. The stump is converted into a fine grade of charcoal, very much like coke. It is destroyed far enough underground to permit plowing over it without further work. There is a cylinder inside the conical cover, and the intervening space is filled with pine knots for fuel. About four hours are required to destroy a stump, so the distillers handle two stumps per day.



TWO STUMPS PER DAY ARE "DISTILLED" AND DISPOSED OF BY THIS METHOD

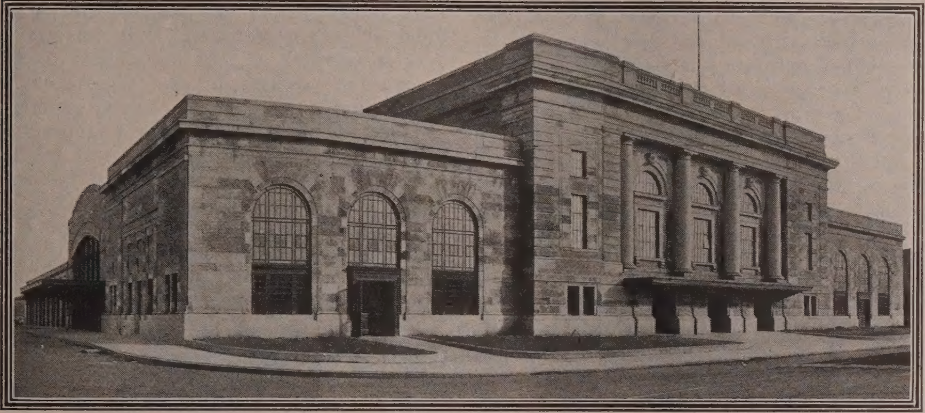
## Apply Bituminous Covering After Concrete Road Has Been in Service

The Maryland State Roads Commission does not apply the bituminous cover to its concrete roads until they have been in service for four or five years, as it has been found that the coat adheres much better after the concrete surface has been worn than if it had been applied when the road was completed.

# New Railroad Terminal in New Orleans Now Open

**Pretentious Station of Trans-Mississippi Terminal Accommodates Texas & Pacific and St. Louis, Iron Mountain & Southern**

IN ITS recently opened passenger terminal in New Orleans the Trans-Mississippi Terminal Railroad Company has provided its tenant railroads, the Texas & Pacific and St. Louis, Iron Mountain & Southern, with as pretentious a station as is to be found anywhere in the South. The terminal is on Annunciation Street, in the heart of the business district, land having been acquired for a short connecting line between the river and the new terminal. The plant includes a freight layout with separate outbound and inbound freight houses, also on Annunciation Street.



NEWEST, LARGEST AND MOST ATTRACTIVE RAILROAD STATION IN NEW ORLEANS

The Trans-Mississippi Terminal Railroad Company was incorporated in 1912 for the purpose of providing adequate passenger and freight facilities in the city of New Orleans for the Texas & Pacific and St. Louis, Iron Mountain & Southern Railways. Up to this time the railroads used the Union Station, owned by the Illinois Central, with which they effected a junction by crossing the Mississippi River at Avondale, about 11 miles above New Orleans; while freight came in by the present route to Gouldsboro, on the south side of the river, the New Orleans side being reached by ferry. The terminal company acquired an area equal to about thirty city blocks, fronting on the river and extending into the business district. The passenger and freight terminals have been built at the inland end of this tract, at a distance of about ½ mile from the river, and a short connecting railroad reaches the ferry from the terminals.

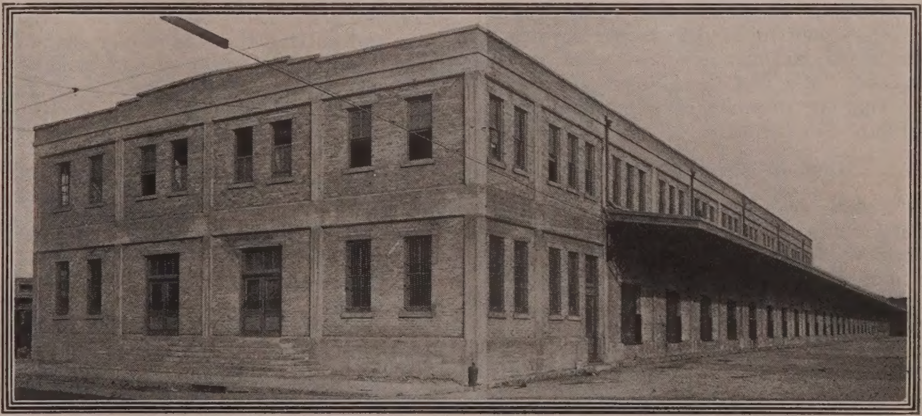
The terminal buildings consist of an inbound freight house, an outbound freight house and the passenger station. Views are shown of the station, and also of the two-story inbound freight house, which, with its reinforced-concrete frame and brick paneling, presents a pleasing appearance.

## STATION BUILDING

The station is laid out with the main waiting room, 100 x 65 ft., in the central section. In the left-hand wing is the lunch room and the ladies' waiting room. In the ladies' retiring room special arrangements have been provided for the care of children, these including iron cribs and an infant's bath—facilities that have already proved very acceptable to families required to wait several hours between trains. In the right-hand wing is the colored waiting room, with ticket office and check room between the two waiting rooms at once serving both and separating them. Behind the station proper is a concourse 234 x 60 ft., running the full length of the building and serving the stub tracks, of which there are five at present, with space provided for five more. The baggage, mail and express building shows in the photograph behind the left wing.

The interior treatment of the waiting rooms for whites consists of light gray marble floors, English vein Italian marble wainscot 10 ft. high, with verde antique bases, and above this point ornamental plaster treatments so as to carry out a complete interior decorative scheme. The colored waiting room is treated with light meadow gray Tennessee marble wainscot 6 ft. high, and above this with Caen stone plaster. All floors throughout are of light gray Tennessee marble. All woodwork in the principal room is of selected mahogany, and all grilles are of bronze.

A feature of the station layout is the use of short tracks. This is due to the fact that the trains are pulled out in lengths of three cars to go on the ferryboat, and are made up into full-length trains at Gouldsboro; and vice versa, trains coming in from the West or North are broken up at Gouldsboro into short trains and brought across the river and into the new terminal in that manner. This eliminates switching on the New Orleans side at the ferry, and makes it possible to spot baggage and mail cars alongside the baggage building, thus keeping trucks off the passenger platform.



CONCRETE TRIM WITH BRICK PANELING GIVES FREIGHT HOUSE PLEASING APPEARANCE

The inbound and outbound freight houses are respectively 70 x 594 and 40 x 818 ft. They are of standard fire-resistant construction, and are heated by steam from the same power plant that serves the station. The two houses are 130 ft. apart, and each is served by four tracks on 12½-ft. centers, thus leaving space for a 12-ft. transfer platform to be built at some later date between the two groups of tracks. Each house has an 8-ft. platform along the track side. Both houses were built on a grade of 0.3 per cent to conform to the natural ground slope.

In the rear of the inbound house is a large concrete platform with a ramp to the street to facilitate the handling of automobiles.

## RECUT PAVING BLOCKS USED

In the granite-block pavements running the entire length of the two freight houses and along the team tracks between the outbound house and the passenger station small blocks 6 x 8 x 7 in. were used, cut by hand on the ground from large blocks from 12 x 14 to 18 x 24 in., taken up in connection with the street changes. This afforded sufficient blocks to do all the necessary paving about the freight houses, which approximated 12,000 sq. yd., and a great saving was thus effected.

In order to eliminate numerous grade crossings and re-route street cars so as to furnish better street car service to the terminals the tracks of the street railway company were relocated, and in this connection Annunciation Street, on which the passenger station and freight houses front, was widened 10 ft., and a neutral ground was provided in the center for street railway tracks.

Large granite paving stones, about 12 x 14 in. in cross-section, and from 20 to 24 in. long, were set in concrete on edge flush with the walls of the freight houses, with the tops 10 in. above the surface of the pavement, to serve as wheel guards in place of the wood waling timbers generally used.

The contractor for this work was J. W. Thompson, of St. Louis and New Orleans. A. F. Barclay was in direct charge of the construction, and with the aid of C. H. Chamberlin, chief engineer of the Texas & Pacific, and J. L. Lancaster, assistant to the first vice-president of the Texas & Pacific and vice-president of the Trans-Mississippi Terminal Company, designed the freight houses and track layout. The passenger station was designed by Favrot & Livaudais, Ltd., architects, of New Orleans.

## Service of Society to Its Members Is Urged

**In His Presidential Address Before the American Waterworks Association This Week President Nicholas S. Hill, Jr., Offers Constructive Measures**

SERVICE of the engineering society to and from its members was the keynote of the presidential address delivered by Nicholas S. Hill, Jr., at the opening session, this week, of the thirty-sixth annual convention of the American Waterworks Association in New York City. He emphasized the need for co-ordination of the local sections and the parent body, better committee work and the appropriation of certain funds to secure this end, and the desirability of improving the general character of the papers and printed proceedings of the association. One of his suggestions embodied the separation of the duties of secretary and editor and the appointment of an experienced man for the latter post to secure the best material for publication and eliminate the commonplace and uninteresting in the papers used. This division of work would leave the secretary free to attend to the larger phases of the society's work. Mr. Hill also answered certain criticisms which had been made about the society's present condition and prospective development. Extracts from his address follow:

"At the present time there are 6000 waterworks in villages, towns and cities of the United States. Of this number only 500 are represented by active or corporate members in the American Waterworks Association. In other words, only 8 per cent of the waterworks men of the country receive the benefits which may be derived from this association. We will never exert the influence which we should until we reach a greater number of those interested in water supply matters. Our field of usefulness must be expanded if we are to take a proper place among the technical associations of this country. The formation of sections brings added financial responsibility, and in order to render proper service to our members our revenues must be increased. The only feasible method of increasing our revenues is by increased membership.

### NEED OF COMMITTEE WORK

"Equally as important as increase of membership is committee work. In no other way can we meet the needs of our members so well as by thorough investigations along special lines, followed by carefully considered reports thereon. Our committees suffer from two handicaps. The first of these is the wide separation of members and the difficulty of convening for conference and consultation. This widely scattered assignment of committee membership is, I believe, largely the outgrowth of the demand for distributing appointments to different sections of the country so as to preclude the possibility of predominance in a given section. If this consideration is to hold, a better distribution would be to divide the committees as a whole among the various sections, so that the members of a given committee could meet with reasonable facility and without unnecessary cost in time and money.

"The second handicap to our present committee work is the absolute lack of funds for its purposes. It is not just to ask busy men to expend their time and energies on investigations and reports without compensation and expect them to go into their own pockets to pay the cost of such investigations as well. I know of no way in which our funds may be expended to better advantage than in appropriations to assist these committees to work out the problems allotted to them.

### PAPERS SHOULD BE EDITED

"I can foresee that one of the most serious problems which the association may have to face in the future will be the added cost of publications resulting from the formation of sections. One of our most urgent needs, therefore, is a careful scrutiny of all papers presented at the section meetings, with a view to eliminating matter of doubtful value, needless repetition of similar topics, and long and wordy papers replete with superfluous detail. Proper editing will accomplish the same result that the meter does in the average water works, namely, reduce waste without restricting needful use.

"The last suggestion brings the increasing demands upon the time of the secretary-editor forcibly to the front. Owing to the growth of the association, the development of sections, the resulting expansion of the publications and the number of papers to be edited, the advisability of separating the office of secretary and editor must be seriously considered. It is doubtful if any one person can attend to the duties of both secretary and editor with a proper regard for each.

"We have reached a stage where it would be well worth while to employ a trained editor for the purpose of securing the very best for publication. This association is largely judged by the character of the proceedings and the quality of the papers which it publishes. One man will be well and completely occupied if he spends the proper amount of time in seeking subjects for new papers which will be appropriate and useful, in finding the best authors for their presentation, in reviewing those papers which have been gratuitously offered and in editing them and putting them in proper shape for publication. The editor should report directly to the Publication Committee, so that the final selection of papers will not rest entirely with an individual. The Publication Committee should be appointed with a view to having the editor in close touch with this committee, so that all matters relating to publications may be efficiently and expeditiously handled.

"The secretary should be free to devote his time to the general correspondence of the association, to attending meetings of the local sections and stimulating their activity, to the accretion of membership, to promoting committee work and the proper relationship between this association and allied societies, to the arrangements for conventions and the numerous other duties which devolve upon the executive officer of an association of this size.

### NATIONALIZATION POSSIBLE

"Finally, I disagree with the statement that the complete nationalization of this association is beyond the realms of possibility. I do not believe that we can be overambitious in our attempts at expansion. The issue of a single, country-wide association was raised by my predecessor, and everyone who has a disinterested regard for the welfare of the waterworks fraternity should weigh its merits and disadvantages carefully.

"When a national association is mentioned some say that its size will destroy the intimate personal relation which has been one of the most valuable assets of the smaller organizations. It is at this point that the sections become useful. It must be remembered that under our present system the larger organization is composed of smaller units, each holding its own meetings at regular intervals. These sections offer an adequate means for close contact among members and insure acquaintanceship for the member who attends the national convention.

"It is pertinent to ask what should be the ideal of this association? My answer is, service—service of the individual to the association; service by the association to the individual and to the country at large.

"What is needed primarily is individual service, as the corporate service of the association is nothing more than the composite service of the individual. What we need, therefore, is servants, irrespective of calling or profession, servants who are willing to do and to help achieve the best results for the association."

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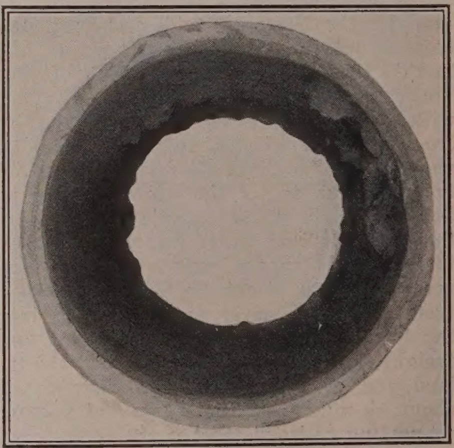
## Pipe Laid During Civil War Still on Duty Under Pressure

THE accompanying photograph is that of a section of 6-in. pipe cut in April from the water distribution system of Chattanooga, Tenn., in service at the time under 70-lb. pressure. The pipe was cut from some three miles of cast-iron main laid under the direction of Gen. U. S. Grant during the occupation of Chattanooga by the federal troops during the Civil War.

At the time of occupation (1864) there was a small pumping plant located on the banks of the Tennessee River, pumping into three small wooden tanks on the side of Cameron Hill. This outfit was taken over by the Government, and later the original owner, undertaking to secure possession of the pumps, evidently found some difficulty in this effort, since according to the chancellor the property "was seized by the U. S. government as property abandoned by rebels in aid of the rebellion."



CAST-IRON PIPE LAID DURING CIVIL WAR WITHSTANDS 70 POUNDS PRESSURE

The foregoing information, together with the photograph, was furnished by James Nisbet Hazlehurst, consulting engineer, who is representing the city of Chattanooga in the appraisal of the city water company's property.

# City Makes Money by Purchasing Plant and Laying Its Own Asphalt Paving

## Flint, Mich., Saved $43,000 Last Year Under Contractors' Estimates by Forming an Efficient Day-Labor Organization

By CLARENCE E. RIDLEY
Cost and Progress Engineer, Flint, Mich.

THE City of Flint, Mich., in the spring of 1915 received bids on approximately 100,000 sq. yd. of pavement, and in spite of the fact that they were the lowest tendered at the time anywhere in this part of the country, they were rejected by the Common Council, and the work was carried out by day labor under the supervision of the city engineer, Ezra C. Shoecraft. Up to that time practically all municipal construction work had been done by contractors. It was therefore necessary to form an efficient construction organization and buy the requisite equipment to carry on the work. The most important purchases were a Hetherington & Berner direct-heating asphalt plant and the necessary street equipment for laying asphalt pavement.

With this organization and with the equipment acquired work amounting to $322,920.08 was done with a total saving to the city under the prices bid by contractors of $43,936.11, or 13½ per cent.

### Close Track Kept of Work

The progress of the work is followed in the office by a progress chart, illustrated herewith. The chart, as filled in for production, shows, for instance, at a glance that Avon Street is finished except 60 per cent of the surface; that the foundation on Broad Street is about 10 per cent complete, and that the excavation on Cornelia Street is 90 per cent complete. This chart is made on tracing cloth and is brought up to date every other day, and a print is taken from it each week on which the date is stamped. These prints serve as a permanent record for the office, showing the stage of the work at all times for each street paved during the year.

This chart keeps the office force in close touch with the field work and enables it to order material intelligently as well as to make sure that the work is progressing according to schedule.

The 4 x 6 in. cards illustrated are used to keep track of the cost as the work progresses. A report card is made out in the office for all foremen for each pay period of two weeks, showing the jobs worked on and the unit cost. These cards summarize the report cards which the foremen are obliged to send into the office each day. By means of them the cost of similar work done by different foremen is compared, bringing out the strong and weak points of the organization. This comparison, being known to the organization, furnishes a strong incentive to efficient work.

The progress cost cards, shown herewith, which are made out for each job, are kept in the same file. On them are entered the amounts of labor cost, under the correct heading of the kind of work, the foremen doing the work and the date of the payroll. Under this system the foremen's report cards may be referred to at any time to trace out the unit cost of any particular job. For example, the $672.48 entered for excavation against Broad Street was done by foreman No. 3, J. H. Brown, and the unit cost for it was 42 cents per cubic yard, as shown by his report card for the July 5 payroll. This method of following the cost of the work is readily referred to and is used daily to ascertain if any part of the work is exceeding the estimate. If such is the case, with no apparent excuse, a remedy is applied before it is too late. It is an accepted fact on large construction operations that some such system of keeping track of cost and progress is a necessity. It was considered all the more desirable for the city because of the scattered nature of the work.

### Quantity of Work Completed

The total amount of pavement built by the city during the 1915 season was 90,031.8 sq. yd., of which 73,799.6 sq. yd. was sheet asphalt. In addition the city also constructed sewers, sidewalks, bridges and other work, bringing the total cost to $322,920.08. At the same time there was spent on contract work $135,320.42, thus making the total cost of improvements for the fiscal year ended Feb. 29 last $458,240.50.

The overhead engineering on all of the foregoing work amounted to $7,095.76, or 1.5 per cent of the value of the work done.

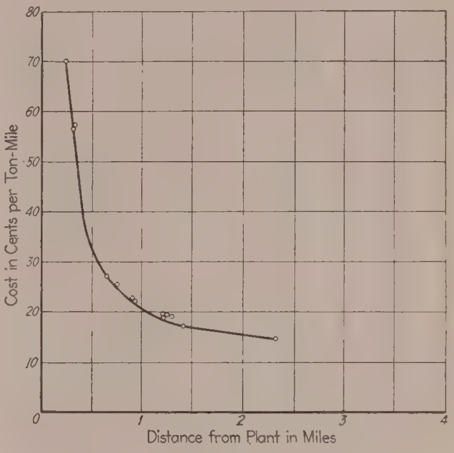
### Costs in Detail

In order to afford a comparison of the figures on unit costs there are given in Table 1 the cost of materials and labor used in the construction of pavements, all the material prices being f.o.b. Flint, except that for cement, which is the price delivered on the line of work.

TABLE 1—UNIT COSTS OF ROAD WORK

| | |
|---|---|
| Asphalt, per ton: | |
| Bermudez | $29.36 |
| Standard | 13.91 |
| Trinidad | 21.37 |
| Texaco | 14.11 |
| Fluxing oil, per ton | 8.85 |
| Binder stone, per ton | 1.28 |
| Limestone dust, per ton | 4.10 |
| Asphalt sand, per cu. yd | 1.09 |
| Concrete gravel, per ton | 0.83 |
| Paving brick, per sq. yd | 0.88 |
| Cement, per bbl | 1.29 |
| Laborers, per hr. for 10-hr. day | 0.25 |
| Teams, per hr. for 10-hr. day | 0.55 |

As the total excavation for paving was more than 50,000 cu. yd., and as but one steam shovel was available, it was necessary to use hand labor on about two-thirds of the work. In the selection of streets the hand labor was favored at all times, which makes the saving shown by the steam shovel even larger than is indicated by the figures in Table 2. In addition to the excavation it was, of course, necessary to have a hand crew working ahead of the steam roller putting the subgrade in condition for concrete. It will also be noted that the cost of this finished grading on work done by the steam shovel is one-third less than on the streets excavated by hand.



COST OF DELIVERING ASPHALT

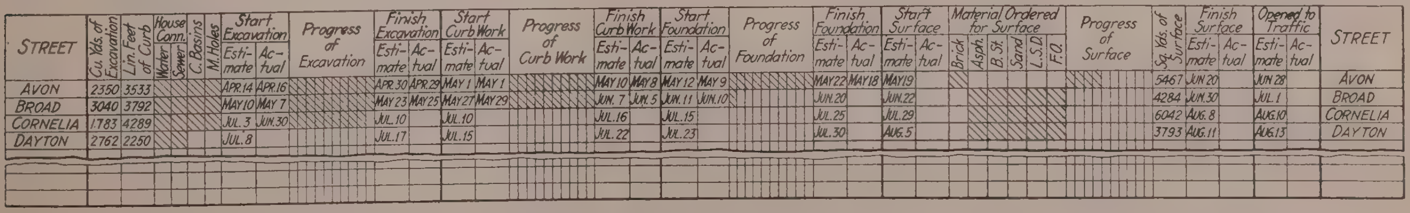
These costs show that had all the excavation been done by steam shovel a saving in cents of 17.3 times 34,464.5 would have been made, which amounts to $5,962.36. Thus, if a new machine had been bought, its cost would have been saved in a single season.

TABLE 2—COMPARATIVE COSTS OF STEAM-SHOVEL AND HAND EXCAVATION

| | |
|---|---|
| *Steam-Shovel Excavation* | |
| Total cubic yards | 16,838.9 |
| Labor cost | $4,965.01 |
| Average cost per cu. yd | 0.295 |
| Average cost per sq. yd., finish grading | 0.042 |
| Total average labor cost per cu. yd | 0.377 |
| Average cost of fuels, oils, etc., per cu. yd. | 0.015 |
| Reimbursement of equipment fund for depreciation and repairs | 0.033 |
| Total average cost of excavation per cu. yd. | 0.425 |
| *Hand Excavation* | |
| Total cubic yards | 34,464.5 |
| Labor cost | $15,913.43 |
| Average cost per cu. yd | 0.46 |
| Average cost per sq. yd., finish grading | 0.063 |
| Total average labor cost per cu. yd | 0.570 |
| Reimbursement of equipment fund for depreciation and repairs | 0.028 |
| Total average cost of excavation per cu. yd. | 0.598 |

### Cost of Curb Work

With the exception of six streets on which brick pavement and stone curbing were used, and two others having straight concrete curbs, a combined curb and gutter was used. Two gangs of fifteen men each were working on this feature of the paving almost all season. By having a finisher on either side of the street the graders could



| STREET | Cu. Yds. of Excavation | Lin. Feet of Curb | House Conn. | | C. Basins | M. Holes | Start Excavation | | Progress of Excavation | Finish Excavation | | Start Curb Work | | Progress of Curb Work | Finish Curb Work | | Start Foundation | | Progress of Foundation | Finish Foundation | | Start Surface | | Material Ordered for Surface | | | | | | Progress of Surface | Sq. Yds. of Surface | Finish Surface | | Opened to Traffic | | STREET |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Water | Sewer | | | Estimate | Actual | | Estimate | Actual | Estimate | Actual | | Estimate | Actual | Estimate | Actual | | Estimate | Actual | Estimate | Actual | Brick | Asph. | B. St. | Sand | L.S.D. | F.O. | | | Estimate | Actual | Estimate | Actual | |
| AVON | 2350 | 3533 | ▨ | ▨ | ▨ | ▨ | APR. 14 | APR. 16 | | APR. 30 | APR. 29 | MAY 1 | MAY 1 | | MAY 10 | MAY 8 | MAY 12 | MAY 9 | | MAY 22 | MAY 18 | MAY 19 | | ▨ | | | | | | | 5467 | JUN 20 | | JUN 28 | | AVON |
| BROAD | 3040 | 3792 | ▨ | ▨ | ▨ | ▨ | MAY 10 | MAY 7 | | MAY 23 | MAY 25 | MAY 27 | MAY 29 | | JUN. 7 | JUN. 5 | JUN. 11 | JUN. 10 | | JUN. 20 | | JUN. 22 | | | ▨ | ▨ | ▨ | ▨ | ▨ | | 4284 | JUN. 30 | | JUL. 1 | | BROAD |
| CORNELIA | 1783 | 4289 | ▨ | ▨ | ▨ | ▨ | JUL. 3 | JUN. 30 | | JUL. 10 | | JUL. 10 | | | JUL. 16 | | JUL. 15 | | | JUL. 25 | | JUL. 29 | | | ▨ | ▨ | ▨ | ▨ | ▨ | | 6042 | AUG. 8 | | AUG. 10 | | CORNELIA |
| DAYTON | 2762 | 2250 | ▨ | ▨ | | | JUL. 8 | | | JUL. 17 | | JUL. 15 | | | JUL. 22 | | JUL. 23 | | | JUL. 30 | | AUG. 5 | | | ▨ | ▨ | ▨ | ▨ | ▨ | | 3793 | AUG. 11 | | AUG. 13 | | DAYTON |

BLUE PRINTS OF PROGRESS CHART MADE AND DATED EACH WEEK GIVE ACCURATE RECORD OF PROGRESS OF WORK ON EACH STREET

TABLE 3—COST OF COMBINED CURB AND GUTTER

| | |
|---|---|
| Total lin. ft. curb and gutter | 47,967 |
| Total number of wagon loads (1½ cu. yd.) gravel | 2,371 |
| Average cost gravel per load at pit | $0.93 |
| Average cost of delivery on job per load | 0.93 |
| Average length in ft. built per load of gravel | 20 |
| Average cost of gravel per ft. | $0.0924 |
| Average length in ft. of curb and gutter per bbl. of cement | 10.7 |
| Average cost of cement per ft. | $0.1206 |
| Average cost of labor | 0.1300 |
| Reimbursement of equipment fund for depreciation and repairs | 0.0214 |
| Total average cost of curb and gutter per ft. | $0.3644 |

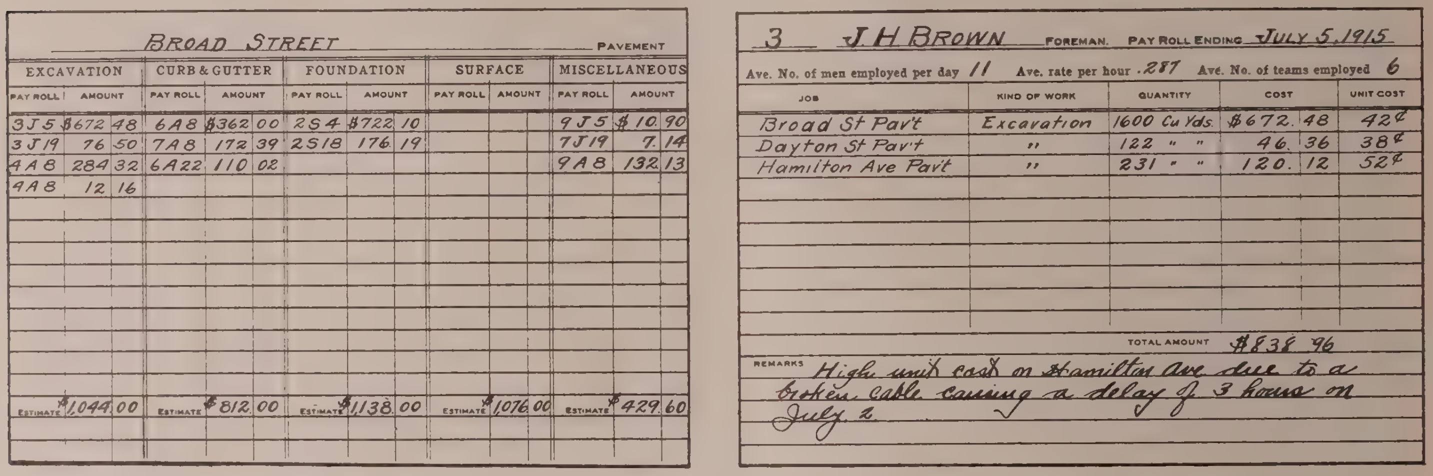
follow the curb gangs very closely. An average of 400 ft. per day was placed. The unit cost of labor and material for this work is as shown in Table 3.

### COST OF CONCRETE FOUNDATIONS

A 6-in. concrete base of 1:3:6 mixture was placed on all the streets. The gravel was unloaded from cars and delivered on the line of the work by teams and wagons. The average length of haul was 0.47 miles, and the average cost per ton-mile was 39.6 cents. It will be noted that for this length of haul the cost falls very close to the ton-mileage curve plotted for hauling asphalt. Table 4 gives the cost of the concrete work for the year.

TABLE 4—COST OF CONCRETE FOUNDATIONS

| | |
|---|---|
| Total number sq. yd. foundation | 90,031.8 |
| Total number carloads gravel | 554.0 |
| Total weight of gravel, in tons | 26,420.0 |
| Average weight of gravel per car, in lb. | 95,300.0 |
| Average cost of gravel on tracks per car | $39.55 |
| Average cost of unloading cars: | |
| (1) Shovelers (hand) | 4.50 |
| (2) Teaming | 9.00 |
| Total number wagon loads (1½ cu. yd.) gravel | 10,819.0 |
| Average number wagon loads per car | 19.5 |
| Average weight of wagon load, in lb. | 4,880.0 |
| Average cost per wagon load on track | $2.03 |
| Average cost per wagon for delivery on job | 0.69 |
| Cost of gravel on tracks per ton | 0.83 |
| Average cost of unloading gravel per ton | 0.091 |
| Average cost of hauling gravel per ton | 0.182 |
| Amount of gravel per sq. yd. foundation, in lb. | 587.0 |
| Cost of gravel per sq. yd. on track | $0.244 |
| Cost of unloading and delivering on street per sq. yd. | 0.08 |
| Total average cost of gravel per sq. yd. | 0.3240 |
| Cost of water per sq. yd. | 0.0075 |
| Number of sq. yd. foundation per bbl. cement | 5.47 |
| Average cost of cement per sq. yd. | $0.2350 |
| Amount of depreciation on equipment | 0.0007 |
| Average cost of labor per sq. yd. | 0.0850 |
| Total average cost of foundation per sq. yd. | $0.6522 |



BROAD STREET PAVEMENT

| EXCAVATION | | CURB & GUTTER | | FOUNDATION | | SURFACE | | MISCELLANEOUS | |
|---|---|---|---|---|---|---|---|---|---|
| PAY ROLL | AMOUNT | PAY ROLL | AMOUNT | PAY ROLL | AMOUNT | PAY ROLL | AMOUNT | PAY ROLL | AMOUNT |
| 3J5 | $672 48 | 6A8 | $362 00 | 2S4 | $722 10 | | | 9J5 | $10 90 |
| 3J19 | 76 50 | 7A8 | 172 39 | 2S18 | 176 19 | | | 7J19 | 7 14 |
| 4A8 | 284 32 | 6A22 | 110 02 | | | | | 9A8 | 132 13 |
| 9A8 | 12 16 | | | | | | | | |
| ESTIMATE | $1,044 00 | ESTIMATE | $812 00 | ESTIMATE | $1,138 00 | ESTIMATE | $1076 00 | ESTIMATE | $429 60 |

3 J. H. BROWN FOREMAN. PAY ROLL ENDING JULY 5, 1915

Ave. No. of men employed per day 11 Ave. rate per hour .287 Ave. No. of teams employed 6

| JOB | KIND OF WORK | QUANTITY | COST | UNIT COST |
|---|---|---|---|---|
| Broad St Pav't | Excavation | 1600 Cu Yds. | $672 48 | 42¢ |
| Dayton St Pav't | " | 122 " " | 46 36 | 38¢ |
| Hamilton Ave Pav't | " | 231 " " | 120 12 | 52¢ |

TOTAL AMOUNT $838 96

REMARKS High unit cost on Hamilton Ave due to a broken cable causing a delay of 3 hours on July 2.

PROGRESS COSTS FOR EACH JOB ARE TRACED TO FOREMEN'S REPORT CARDS (AT RIGHT) IF EXCESSIVE COSTS APPEAR

### BRICK SURFACING

It has already been stated that but 16,232.2 sq. yd. of brick pavement was laid. As this amounted to only about 18 per cent of the total paving and was made up of comparatively small jobs, its cost is not as low for this class of work as the main surfacing costs are for asphalt paving work. The average cost of brick paving, with a stone curb and 6-in. foundation, excluding the cost of excavation, was $2.128 per square yard. The amount of material per square yard of surface was 40 brick, 1/40 bbl. of cement, 1/25 load of cushion sand and 1/200 load of slushing sand. The cost of material and labor for these items per square yard is shown in Table 5.

TABLE 5—COST OF BRICK SURFACING

| | |
|---|---|
| Brick, f.o.b. Flint | $0.88 |
| Delivering brick on line of work | 0.08 |
| Cement | 0.03 |
| Cushion sand | 0.04 |
| Slushing sand | 0.01 |
| Fixing sand bed, laying, rolling and slushing brick | 0.16 |
| Total average cost of brick surface | $1.20 |

### LARGEST SAVING ON SHEET ASPHALT

The greatest saving was made on sheet-asphalt surface. Enough money was made on this work alone to more than pay for the plant and equipment twice over. Exclusive of grading, the average cost of asphalt paving was $1.51 per square yard. All of the sheet-asphalt pavements were laid in residence districts with widths of 24 and 26 ft. Texaco asphalt was generally used in the binder with an average penetration for the season of 75.5. Mexican asphalt mixed half and half with either Bermudez or Trinidad was chiefly used in the top with an average penetration of 65.3. An average of 24.9 per cent of the sand used passed an eighty-mesh screen, and 29.3 per cent of the total aggregate used passed this screen.

The percentage of bitumen for the season averaged 10.9. The total cost of the plant and equipment is listed in Table 6.

Of the above items of plant, the equipment, asphalt plant, wagons and roller were allowed a depreciation of 20 per cent, and the rest a depreciation of 10 per cent, amounting in all to $2,803.63. The asphalt plant is located on the Pere Marquette Railroad, as near the center of the city as possible. The average hauling distance during the past season was 0.96 miles, but one haul of more than 2 miles and one of less than ¼ mile occurred. The average cost of delivering the asphalt during the year amounted to 23.7 cents per ton-mile. The asphalt surfaces placed consisted of 1½ in. of binder and a 1-in. top. The average amounts of material used and cost per square yard of surface are given in Table 7.

TABLE 6—COST OF ASPHALT PLANT

| | | |
|---|---|---|
| Original cost of plant erected | $9,245.00 | |
| Cost of foundation | 380.76 | |
| Kettle shed | 493.92 | |
| Buildings (office, engine room and limestone dust shed) | 742.88 | |
| Flux oil tank | 302.89 | |
| Miscellaneous equipment for plant and street | 638.14 | |
| Total cost of plant and equipment | | $11,803.59 |
| Cost of five asphalt wagons | $824.76 | |
| Cost of asphalt roller | 2,350.00 | |
| Total cost of street equipment | | 3,174.76 |
| Grand total | | $14,978.35 |

The total yardage of sheet asphalt, 73,799.6, times the difference in the contract price offered for the work and the actual cost, 38 cents per square yard, equals $28,043.85. Less $2,803.63 depreciation, this amounts to $25,240.22 saved on the asphalt surfacing alone.

### EXTENSIVE WORK CONTEMPLATED FOR THIS YEAR

Petitions have already been presented to the Council for more than 120,000 sq. yd. of additional sheet-asphalt pavement to be built during the coming season. In addition to this plans are complete for constructing

TABLE 7—AVERAGE AMOUNTS OF MATERIAL USED, AND TOTAL COST PER SQUARE YARD

| Binder Material | Amount per sq. yd. | Cost per lb. | Cost per sq. yd. | |
|---|---|---|---|---|
| Texaco asphalt | 5.47 lb. | $0.007055 | $0.03859 | |
| Fluxing oil | .15 lb. | 0.004425 | 0.00066 | |
| Sand | 16.35 lb. | 0.000425 | 0.00695 | |
| Binder stone | 89.70 lb. | 0.000640 | 0.05740 | |
| Cost of material in binder | | | | $0.1036 |
| Top | | | | |
| One-half Trinidad and one-half Mexican | 18.50 lb. | 0.008820 | 0.16317 | |
| Fluxing oil | 2.20 lb. | 0.004425 | 0.00973 | |
| Sand | 147.15 lb. | 0.000425 | 0.06254 | |
| Limestone dust | 15.20 lb. | 0.002050 | 0.03116 | |
| Material in top | | | | $0.2666 |
| Coal, electric power and water | | | | 0.0200 |
| Labor at plant | | | | 0.0844 |
| Labor on street | | | | 0.0668 |
| Teaming | | | | 0.0330 |
| Salary of expert, engineer in charge and assistants | | | | 0.0300 |
| Total average cost of asphalt pavement per square yard | | | | $0.6044 |

sanitary and storm sewers on a much larger scale than during the past year, when more than 21 miles of sewers were completed. The new equipment purchased to prosecute this work includes a sewer excavator, another steam shovel and a crane for unloading gravel. It is expected that practically all of this work will be done by day labor, and the engineering department is ambitious to make at least as good a record as that of the past season.

### Double-End Motor Trucks Clean Los Angeles Streets

FIVE auto trucks carrying 1200-gal. tanks have recently been put in service by the street-cleaning department of the City of Los Angeles. The trucks are equipped with both front and rear nozzles; those in front for flushing and those behind for sprinkling. The nozzles are so constructed that there is no overlapping of the streams, and the spread is such that one trip covers the 50-ft. streets from curb to curb. Water is delivered at a pressure of 60 lb., supplied by a centrifugal pump direct-connected to the truck engine. The trucks are being operated two eight-hour shifts per day, covering a distance of 30 miles in each shift, and are said to be making a very creditable cost account showing. The trucks are of the Moreland make.

DOUBLE-END TRUCKS CLEAN 50-FT. STREET FROM CURB TO CURB IN ONE TRIP

### Sawed Lumber Piling

Sawed lumber instead of bare poles for piling in the prevention of levee breaks along the Mississippi River, first tried at New Orleans, has proved so successful, according to the National Lumber Manufacturers' Association, that the use of wooden interlocking piling is said to be spreading rapidly. An advantage claimed for the wooden interlocking piling is that it does not buckle and bend when driven. These piles have also been used in caisson work, sewerage and waterworks excavations.

# Are Rock-Fill Dams Safely Designed?—What Failure of Lower Otay Dam Teaches

### Study of Disaster Indicates That Downstream Surface Must Be Able to Withstand Heavy Overpour for Short Period Without Gorging of Fill

By GEORGE S. BINCKLEY

Consulting Hydraulic Engineer, Los Angeles

THE MORE disastrous a failure is, the more valuable are its lessions. In engineering especially, much is learned from failure—little from success. The construction and continued existence in service of the Lower Otay dam taught nothing. The margin of safety that held it together under a head of water 15 ft. below the spillway level in 1907 is unknown, and can never be known.

But the failure of this recklessly conceived and crudely constructed example of lay engineering has a value of its own. So long as it stood up, no matter how fearfully narrow the margin by which it stood, the fact that it *did* stand was to the layman sufficient and triumphant proof of its safety. Even well qualified engineers were mild in their criticism, for to question the safety of this dam was to invite a demand for mathematical proof of its weakness—something not easy to furnish with a desirable degree of finality. The fact that the nature of the stresses and the elements of resistance in a pile of loosely dumped rock are not susceptible of mathematical determination probably accounts for a great deal of the freedom from drastic criticism to which this dam would otherwise have been subjected.

Now the Lower Otay dam is gone, and criticism may rest on the safe basis of disastrous fact. So we find that, quite aside from descriptive or historical articles, this failure has brought out a number of others of a critical or analytical character, and there can be little doubt that the dissection of this unpleasing corpse will be profitable to the engineering profession.

Where a type of engineering construction, even though it be approved by ripe judgment and established by experience, lacks a firm and rational mathematical basis, it is wholesome that from time to time it should be subjected to severe question. Of all types of engineering structures bridge design would seem to be that most completely susceptible of treatment by rigid mathematical processes. Yet the failure of the greatest bridge ever attempted demonstrated unsuspected imperfections and taught great lessons. In the design and construction of dams judgment far more than mathematics must control. Upon a mathematical skeleton must be built up a structure that must not merely stand but stand safely.

Those elements in the design of a dam that are calculable are few and comparatively simple; the many that must be determined by the judgment and experience of the engineer are of equal or even superior importance. So in the design of a rock-fill dam the wise engineer will trust his mathematics only so far as he must. At best his results will be suggestive, and not finally controlling. He knows, or should know, that an embankment of rock so steep that its surface represents the natural angle of repose of the material is, at its surface, in a condition approaching unstable equilibrium. Hence he will make the slope of the lower angle, not upon the basis of a mathematical determination, but in accordance with his personal judgment and experience. He will contemplate the dangers that may threaten his structure, and in the light of his own knowledge and with proper regard for established practice he will provide safeguards.

### CONDITION AT LOWER OTAY DAM

In considering the rock-fill dam as a distinct type of construction, it will be helpful to analyze briefly the general conditions that existed at the Lower Otay dam at the time that it failed. Certain of these conditions are not open to question, while others must be deduced from evidence.

In the first place, full hydrostatic pressure existed all over the upstream surface of the steel diaphragm or the thin enclosing walls of concrete on the axis of the dam. Hence the only resistance offered to this pressure is found in the mass of rock on the downstream side of the diaphragm. But in adition to this hydrostatic pressure there existed an additional pressure against the diaphragm due to the weight of the upstream rock fill. Although it is difficult or perhaps impossible to state with mathematical certainty just how much this additional pressure amounted to, a rough investigation by Bligh's method indicates that the aggregate of this pressure and the hydrostatic component would be nearly or quite double that of the hydrostatic alone, although the direction of the resultant of these two forces would fall below the horizontal.

It is hardly too much to say that the resistance that a large mass of loose rock will oppose to horizontal displacement is wholly unknown. The recorded failures of rock-fill dams illuminate this phase of the problem but little, as they always seem to have been complicated by conditions of erosion or overpour. Hence we have here a condition on the upstream side of the dam defined by fairly determinate forces, opposed on the downstream side by a mass having qualities of resistance of which nothing definite is known.

### RAPID CHANGE WHEN DAM WAS OVERTOPPED

So much for the conditions existing with a full reservoir. The dam may sustain its load, but with what margin of safety cannot be known. The Lower Otay dam did actually withstand the pressure of a full reservoir. But when it was overtopped a rapid and profound change in the conditions controlling its stability—probably slight enough to begin with—took place. The voids in the loose rock fill on the downstream side filled with water which, against the resistance of the tortuous channels through the voids, forced its way out of the mass downstream.

The excellent evidence obtained from eyewitnesses and graphically arranged in the three diagrammatic sketches in the Engineering Record of Feb. 12, 1916, page 225, proves that the earthen dike which was built on top of the dam to a height of about 5 ft. above the top of the steel and concrete core was first overtopped by from 4 to 6 in. of water, and was then carried out near the center and probably down to the top of the steel diaphragm. The flow through this rapidly widening break in the dike was sufficient to gorge quickly the already partly saturated rock fill and break through the lower face with sufficient force to displace large rock from the steep slope. As this slope was built on the natural angle of repose, taking material from the toe naturally tended to put into motion everything on the slope above, and the sudden reduction in the effective weight of the rock fill due to its partial submergence, aggravated by the disruptive force of the hydrostatic pressure within the mass itself, made destruction swift and inevitable. As a matter of fact there was an interval of twenty minutes between the time the first serious break occurred in the earth like on top of the dam and the moment of failure of the structure itself—a period quite long enough for the downstream portion of the rock fill to become disastrously gorged.

Considerable stress has been laid by other writers upon the fact that this rock fill contained a great deal of fine material, and the writer is inclined to agree that this was an element of weakness in reducing the volume of the voids and retarding the escape of water from the fill. But he does not believe that the destruction of this or any other rock-fill dam can be ascribed to the actual erosive effect of the overpour, either by the displacement of material on the surface or the washing of it out from within the fill. All evidence is against such a hypothesis. But that the gorging of such a mass with water reduces its effective weight and consequently its resistance to displacement, and that under such conditions there must exist a disruptive force within the mass itself due to hydrostatic pressure, there can be no question. Hence in view of the fact that the Lower Otay dam actually resisted the static pressure due to a full reservoir, but failed when overtopped, the writer believes that to the existence of the conditions described above must be attributed the failure of this dam.

### HOW WOULD MORENA DAM HAVE BEHAVED?

The question naturally arises: Would the Morena dam have survived the same conditions that destroyed the Lower Otay dam? As engineering works the two structures are not to be compared. Yet it is pertinent to examine the dangers that threatened the Morena dam at the time of the recent floods.

In the first place, for some reason not apparent, racks of railroad iron, spaced 1 ft. apart, were placed in front of the spillway, which in turn was provided with radial gates by which it could be closed completely. It is plain that it was intended to make possible the utilization of storage to within a few feet of the top of the dam—in fact it actually rose to within 18 in. of the top of the parapet. Leaving aside what would appear to be the very doubtful propriety of such an arrangement, the fact is that the large amount of floating débris brought down the reservoir by the rapidly rising water promptly stopped the flow through the spillway so completely that with a head of 3 ft. of water above the spillway level and all the radial gates wide open the depth of water on the floor of the spillway was but 3 in. With the spillway entirely useless, a few hours more of heavy rain would have produced an enormous overpour.

It is, the writer believes, extremely unlikely that the Morena dam would have sustained such a condition for more than the short period that would have been required for the gorging of the fill. While the lower angle of its downstream slope provided a stability superior to that of the Lower Otay dam, the greater distance which the water from the overpour would have to traverse before escaping at the toe of the fill would increase the extent of the gorging and aggravate the loss of effective weight of the mass and the disruptive force of the hydrostatic pressure within the mass itself. Actual erosion of the surface of the fill by the flow of water over it would probably not be a factor at all, but displacement of material from the surface of the slope by the escape of water from within would probably be an important or even vital element in the final catastrophe.

The destruction of the Lower Otay dam carries one kind of lesson. But the narrow escape of the great Morena rock fill carries another and perhaps more valuable warning. The Otay dam cannot be considered as an example of engineering design or even good construction. But the Morena dam is the work of an engineer of standing and experience, and is therefore more properly subject to engineering criticism where weakness or error in design has been developed. The lesson in both cases is plain. From the Lower Otay we again have tragically emphasized the folly of intrusting engineering works to untrained or reckless hands. And from the narrow escape of the great Morena rock fill few engineers will fail to realize with the shock of sudden remembrance the grim hazards of an obstructed or insufficient spillway.

### WHAT ROCK-FILL DAMS REQUIRE FOR SAFETY

The writer believes it proper to conclude that a rock-fill dam that is at all likely to be overtopped must, for even reasonable safety, be provided with a downstream surface that will carry a heavy overpour for a short period without leakage through into the mass below sufficient even partly to gorge the fill, and that to secure a reasonable stability the angle of the downstream slope should be considerably lower than the natural angle of repose of the material of which it is constructed.

And finally, in view of the fact that no failure of an arched masonry dam has ever been recorded—even though this principle has been ignorantly and recklessly applied—it seems very likely indeed that where the conditions are favorable a well-designed arch of concrete or masonry will prove not only a better and safer structure but actually cheaper than a rock-fill dam designed and constructed with due reference to safety and watertightness.

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# Engineers Investigate Charges Against City Engineer

**Show That Official Directed Work Efficiently and Safely—Accusations Not Based on Actual Facts or Engineering Knowledge**

A precedent has been established by the Canadian Society of Civil Engineers in coming to the aid of an unjustly accused member of the profession. G. W. Craig, city engineer of Calgary, was recently accused by one of that city's officials of neglect in certain details of the construction of a bridge. A committee of engineers, after making a thorough investigation, declared the charges against the city engineer and his associates to be without justification.

For nearly a year there had been public criticism of the Calgary engineering department by one of the aldermen. He had at one time been waterworks engineer, but was dismissed when that office was abolished for economical reasons and the waterworks department placed under the direction of the city engineer. He was later elected an alderman and also opened an office for the practice of consulting engineering. The work of the city engineering department was greatly handicapped by his continual fault-finding.

Finally the alderman's criticism focused itself upon the construction of a reinforced concrete arch bridge being built by the city over the Bow River at Center Street. Charges made to the city council by this alderman reflected upon the ability and good judgment of the city engineer and his associates. G. W. Craig, city engineer, is an associate member of the American Society of Civil Engineers. The local members of that organization took the matter up with him, as it was evident that if the facts were as Mr. Craig presented them his reputation as an engineer was being attacked largely for political reasons.

### ENGINEERS OFFER FREE SERVICE

As this was a matter between engineers it was thought that it should be settled within the profession. The executive board of the Calgary branch of the Canadian Society of Civil Engineers offered to investigate the matter without charge. Accordingly, the Calgary city council requested the alderman to draft his charges and the city engineer to answer them in writing. Three members of the Calgary branch of the Canadian Society of Civil Engineers were selected as an investigating committee. The alderman's charges were presented in writing, together with the city engineer's reply.

Public meetings were held, at which the alderman preferring the charges refused to appear for examination. On the other hand, the city engineer, the engineer in charge of design and construction of the bridge and the city chemist who had charge of the city testing laboratory submitted willingly to a fair examination on the points at issue.

The charges involved the use of unsuitable re-rolled steel in the structure and extravagance in the testing; neglect or carelessness in not carrying the foundations of the north retaining wall to rock and failure on the part of the engineering department to submit the design to a consulting engineer for indorsement.

### CHARGES DECLARED FALSE

After reviewing the evidence the committee of engineers decided that the cost of testing will be reasonable, and in all probability will be less than the cost of a similar service performed by an inspection company. The engineers also decided that the use of re-rolled steel in certain parts of the structure was warranted on the ground of economy, and that in view of the relatively high grade of the material the integrity of the structure had not suffered.

Failure of the north abutment from the causes outlined by the alderman was found to be only a remote possibility. The committee was also of the opinion that the additional cost of carrying the foundation in question to rock would not be justified by any extra security so obtained. The committee was unable to find that employing a consulting engineer had ever been suggested nor was such a course thought necessary.

After carefully reviewing both the engineer's reports and the charges against him, as well as all of the evidence, the committee of engineers could find no basis for the charges and decided that the engineers had directed the work in a creditable manner. Information about the work had not been withheld nor had any legal or engineering requirement been overlooked.

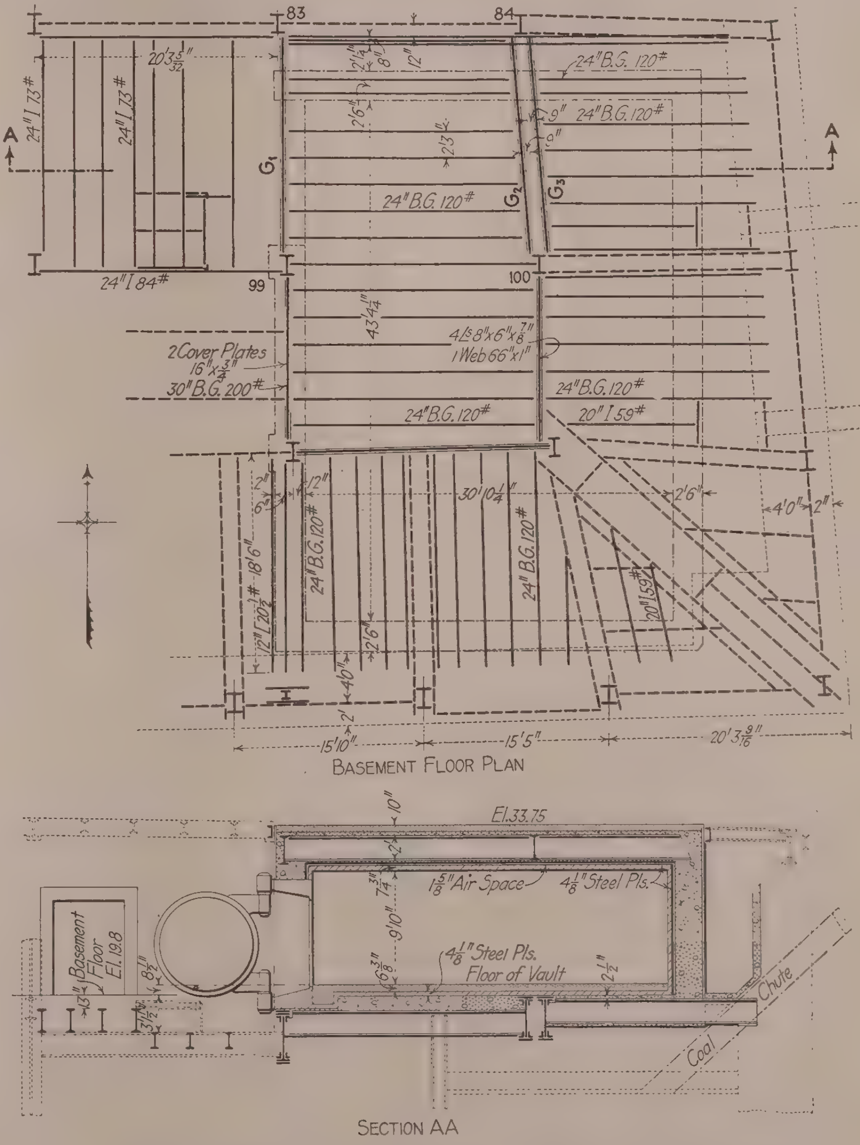
## Liner Plates Used in Sewer Tunnel

Although the ground encountered in driving the tunnels for the intercepting sewer in Broadway and North Water Streets, Milwaukee, is hard clay which is practically self-supporting, the contractor is using steel liner plates. While these plates are expensive in first cost their use has proved economical in labor, according to the annual report of T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission. From gratuitous information given to the contractor before the beginning of the work by those who had done underground work in the city the contractor became convinced that these tunnels would prove troublesome and expensive. He therefore provided full air equipment and steel liner plates. The air equipment has never been used. The bore is lined with steel plates throughout, furnished and placed at the contractor's expense. These plates will be left in, and the concrete shell forming the sewer will be built inside of them. They permit of the removal of the minimum amount of excavation, are easily handled and put in place by one or two unskilled men, require no braces, thus leaving the bore free for operating material cars and placing the concrete, and have many other advantages over timber lining.

# Heavy Vault Floor Framed into Existing Columns in Basement of Equitable Building

### Difficult Details Encountered for Connections of Steel Girders to Old Columns—Load of 3,000 Pounds Per Square Foot Specified

ESPECIALLY difficult, both in the general design and in the practical detailing of connections to the existing columns, are the problems encountered in the installation of a heavy steel-frame vault to be used by the Federal Reserve Bank for the storage of gold specie and valuables in the basement of the Equitable Building, New York City. These problems were intensified by the extremely heavy load of 3000 lb. per square foot prescribed in order to allow for excessive concentrated loading and for the possible large uniform live loading on the floor of the vault. After outlining the determining requirements for work of this type, there is here given a typical detail of a connection between the new floor girders and the existing columns.



PLAN AT BASEMENT FLOOR AND SECTION THROUGH NEW VAULT FRAMING

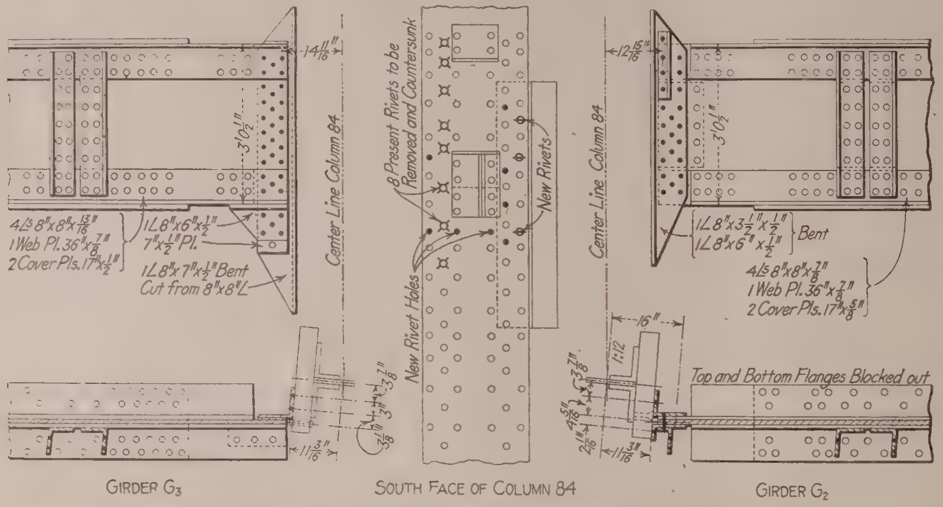
### NEW FRAMING IN BASEMENT

As indicated by the accompanying plan view, the new vault is to be placed in the southeast corner of the basement of the Equitable Building. The floor is supported on I-beams carried on the south and east sides by the 6-ft. foundation-wall caissons of the building, and by interior girders framing into the existing columns. The direction of the beams was selected to transfer the load to the foundations by the most direct path. Between columns 84 and 100 two plate girders spaced 18 in. apart on centers were necessary in order to make the connections to the columns practicable and keep the weight of single pieces to be handled within the capacity of the erection rigging.

The first-floor framing plan forming the ceiling for the vault is simple. It consists of 24-in. 73-lb. I-beams spaced 2 ft. 3 in. on centers, all running east and west and framing into 24-in. 140-lb. girder beams, as seen in the section AA. The east ends of these beams rest on the concrete wall of the vault, which is lined throughout on the inside with 4⅛-in. steel plates.

The assumed dead load for the vault floor was 600 lb. per square foot and the assumed live load 3000 lb. per square foot for the beams and girders and 1500 lb. per square foot for the columns. The girder $G_1$ between columns 83 and 99 carries a huge steel door and frame weighing 96½ tons, the door alone weighing 50 tons. No reinforcement for the main columns, which are of the built-up I-section type, was required to carry the relatively small additional loads, because the slenderness ratio $Z/r$ was decreased by the new framing, and because the revised New York building code allows slightly higher values (for these slenderness ratios) than were permitted when the building was designed in 1912.

The determining requirements in making the connections to existing columns were two-fold. In the first place, the details of the connections between new steel and old columns had to be devised in such a manner as to avoid weakening the main columns. Thus, in some cases, rivets must be added before the existing rivets connecting the cover plates with the main angles are removed. In the second place many difficult problems in devising practicable rivet connections had to be solved. Regular schedules of the successive operations for doing the work are drawn up, with drawings stating what new rivets must be inserted, what rivets cut out, where countersinking is necessary and what new holes are to be drilled.



DETAILS OF RIVETED CONNECTIONS BETWEEN GIRDERS AND COLUMN 84

### TYPICAL JOINT DETAILS

The accompanying detail drawing showing the connection between girders $G_2$ and $G_3$ and column 84 is reproduced to illustrate one of the problems encountered. In this case it was found impracticable to use a single girder between columns 84 and 100 and make the end connections. It was therefore necessary to frame into the column by a detail which required the eccentric and complicated end connections shown. To avoid interference with rivet heads by the girder $G_2$, one row of the 1⅛-in. rivets in the column must be cut out and new countersunk rivets driven. In preventing bulging of the cover plates on the columns three new rivets are added on the east side where the eccentric connection for girder $G_3$, using a single heavy connection angle, requires the removal of both rows of existing rivets on that side of the column.

These details and the design of the framing were worked out under the personal supervision of George Simpson, chief engineer for the contractors, the Thompson-Starrett Company of New York City. The steel is furnished by the Hay Foundry & Iron Works of Newark, N. J.

# John Nolen Says City Planning Is for Small Cities as Well as for Large Ones

## Holds That Younger Towns Have Opportunity to Avoid Established Mistakes of Older Ones, Not to Be Corrected Now Except at Great Expense

CHALLENGING the common belief that city planning is for large cities only, John Nolen of Cambridge, Mass., fellow of the American Society of Landscape Architects, averred in a paper read at the Eighth National Conference on City Planning at Cleveland this week that the best opportunities are rather in the smaller places. This, he stated, is because the larger places have already grown up wrong, and only the gravest mistakes can be corrected except at great expense, while almost any change is feasible in the small city. He thinks there should be an advisory state planning board, but concedes that even with such a board much would depend upon the local community. He would urge the community not only to adopt safeguarding regulations as to streets, parks, building restrictions and the like, but also to employ experts to prepare a comprehensive city plan at the earliest possible date.

Extracts from his paper follow.

### LARGE CITIES AND SMALL

A notion prevails that comprehensive plans are needed only for large cities. The reverse of this is nearer the truth. In large cities the conditions are comparatively fixed and unyielding. Comprehensive planning, especially with our present legal limitations, can occupy only a limited field in larger places, relieving only the worst physical conditions. But with the smaller cities the opportunity is different. Comprehensive planning may be to them of far-reaching and permanent service, for there is scarcely anything in them that may not be modified or changed. Streets can be widened, transit systems properly outlined, building districts defined, park and recreation areas selected, public buildings grouped and a scheme of planning adopted which will have unity and character. We have expended too much of our time and money in almost futile consideration of the ills that afflict our great cities, instead of providing against an unnecessary repetition of those self-same ills in cities that are to-day small, but in which there are clear indications of steady growth.

Two forms of town and city planning have required attention in the past, and will continue to require attention in the future. The first is concerned with villages and towns planned in advance of a settlement of population; the second with existing towns and cities which must be replanned or remodeled to meet new and insistent requirements. Planning a town or village before its settlement has great advantages, but the opportunity is only occasionally possible. The complex influences which determine the selection of the sites for towns and villages and future cities and the locations of the first streets and buildings must usually be left to work out their results by natural forces.

When, however, a small population has been attracted to a village or town by natural causes and there are indications that because of strategic situation, climate, natural resources, the inevitable trend of trade and commerce, the wealth and energy of citizens, or other forces a city of some importance is to be established, then if action is taken soon enough it is entirely practicable and certainly economical to replan the existing town so as to provide more satisfactorily for its present and its future needs.

The planning and replanning of the smaller cities take on added importance when we consider how great is their number, the population affected and their relative rates of increase. Of the total population of the United States, according to the census of 1910, 54.7 per cent is still rural; only 46.3 per cent is urban. Of this 46 per cent more than one-half, or 25.5 per cent of the total population, is included in towns and smaller cities with a population ranging from 2500 to 125,000. Moreover, the relative increase of population is greater in the smaller cities.

### NEED OF ADVISORY STATE PLANNING BOARD

Progress in planning for small places under our present form of civic organization is apt to be slow unless cities can have the advice and service of qualified men. Two things would seem to be necessary. In the first place, a state planning board or department of municipal affairs; and in the second, the early adoption by cities, towns and even villages and rural districts of safeguarding regulations and the preparation of surveys and general plans. Like many state boards of health, the proposed state planning board or commission could be largely advisory. The one exception might be in dealing with those matters which concern two or more communities.

Such a planning board would be organized to secure:

1. The identification of the administration of public health, housing, highways and other matters with broad city-planning projects.
2. The employment of technically qualified men in dealing with the physical, sanitary, social and financial problems of cities.
3. The proper regulation of local finance, local expenditures and local indebtedness.

4. The adjustment of public franchises directly connected with city planning.

5. The application of fair and right principles in regard to the extension of municipal boundaries or the co-operation between adjacent communities.

The purpose of such a state board is not to check or limit local government, but to offer it aid and help it to be efficient and economical. It should be recognized that even with such a board good city planning would still depend largely upon the efficiency of the city government and the successful organization and utilization of the best forces of the community, both public and private.

### Safeguarding Regulations for Towns and Cities

The safeguarding regulations which should be considered and, if approved, adopted by the various local authorities themselves are as follows:

1. The minimum width for main thoroughfares and the public reservation of land necessary for the same.

2. Provision for narrow streets and roadways of short length in many residential areas.

3. The establishment of building districts defining zones for factories, dwellings, etc., with regard to use, and also the bulk (height and area) of buildings allowable.

4. Provision for some systematic setting aside of recreation open spaces for public use in connection with the extension of the town or city, just as streets are now usually set aside.

5. The laying out or approval of land subdivisions by local public authorities.

In connection with these safeguarding regulations it should be established that property would not be deemed to be injuriously affected by reason of provisions which prescribe the minimum space necessary around buildings, their height, area or character, or which limit the number of buildings to be erected in a given area. There should also be public power to purchase or expropriate land necessary for these wider public purposes, including, when desirable, land within 200 ft. of the boundary lines of any street, park or other public property.

The town or city should have all the power necessary to make systematic local surveys, and to provide a general town or city plan, including the appropriation of the necessary funds, which, in view of the fact that such surveys are largely for the benefit of future generations, might, if it were deemed advisable, be provided for by bond issues. In order that the regulations already referred to shall be wisely placed, a general plan based upon a local survey should be prepared as early as practicable.

### Principal City-Planning Failures of Large Cities

Some of the principal shortcomings of large cities from the city-planning point of view are the following:

1. Inadequate systems of arterial streets, including with them a proper consideration of transit problems.

2. Neglect of the regulation of city building according to districts, defining the use of various areas, with the regulation of height of buildings, percentage of lot to be covered, etc.

3. Postponement until it is too late of the reservation of ample lands for park systems and local recreation grounds.

4. Failure to recognize early the advantages, from many points of view, of an orderly grouping of public buildings, conveniently and appropriately located.

5. Neglect of that kind of city planning which would give unity and character to the city as a whole, and enable it better to discharge its functions.

### Conclusion

City planning can learn much from a study of the history, method and recent success, to say nothing of the rich promise for the future, of preventive medicine. Formerly medical practice was largely a negative program, a program of "don'ts." Now it is mainly positive and constructive. So it must be with town and city planning. The merely corrective and therefore negative program must be displaced by one that is more positive and constructive. Misconceptions, false traditions and hollow superstitions must be put aside. Most persistent of all errors, and in some respects most difficult to combat, is the idea that the beauty of a city consists of mere adornment, that it is on the surface of things, and that beauty in a city is somehow different from beauty in a ship, an engine, a schoolhouse or a factory, and that it is not mainly functional perfection.

In broader matters, in phases which concern many physical aspects combined in one, the notion is widespread that it is too much to expect unity, character and distinctiveness in a city; or if not, that it must be left to come by chance and not by art. Not only in physical phases, however, but in law and expert services and costs, new ideas must, for example, displace such old ones as that laws and constitutions cannot be changed, and that judicial decisions must always be a generation behind the times; that anyone can plan a city, and that trained men have nothing to contribute to the solution of technical problems. Finally, the idea must pass that city planning is a new way of spending money, and not a new way of saving money, and making the most of what we have.

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# The Automobile and the City Plan

## Nelson P. Lewis Discusses the Growth of and Present Tendencies in Motor Vehicular Transportation, and Suggests How They Should Be Met

A FACTOR of rapidly growing importance in city planning is the motor vehicle. The problems introduced and how to meet them were discussed at length at the Sixth Annual Conference on City Planning in Cleveland this week by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City. Mr. Lewis presented much statistical matter pertaining to American and European cities, as well as abstracts of replies received from motor-truck manufacturers to circular questions asked by him. In his conclusions he insisted that the manufacturers must adapt themselves to existing conditions rather than attempt to force changes in those conditions.

"The problem of the motor vehicle in its relation to the city plan," said Mr. Lewis, "is the avoidance of congestion due to concentration of traffic on certain streets and the congestion and confusion which will result from mixed traffic or the presence on the same street of vehicles of different sizes and speeds. The tendency toward centralization has presented a number of serious problems. The garden-city movement and the efforts to control the height, arrangement and use of buildings are protests against this tendency and will, if successful, do much to solve the problem of traffic congestion, more particularly the trouble due to mixed traffic. A mere statement of the number of vehicles passing through a given street does not give an adequate idea of the resulting congestion. Some offer far more obstruction to traffic than others, depending upon their size, speed and flexibility, while the roadway capacity may be such as to cause or prevent congestion."

For purposes of comparison an attempt has been made at standardization in London, and the results were presented in tabular form by Mr. Lewis. The degrees of obstruction assigned to different vehicles range from ½ for cycles to 10 for slow two-horse trucks and the same for electric trams. In general the motor vehicle is rated only about half as obstructive as the horse vehicle, and the fast outfit only half as bad as the slow.

### Special Problems of Heavy Trucks

Mr. Lewis's attention was directed primarily, however, to heavy commercial vehicles. "So far as the obstruction of traffic is concerned," said he, "the small commercial vehicles present the same problems as do those designed for pleasure traffic, but in the case of the truck of large capacity an entirely different set of problems is presented, these being (1) damage to pavements by reason of excessive wheel loads, (2) obstruction to traffic by reason of low speeds and (3) occupation of an undue proportion of the street owing to their constantly increasing dimensions."

Feeling that it would be impossible to plan intelligently for the future unless the future demands as to both space and sustaining power to be made upon the city streets could be known, Mr. Lewis has attempted to secure from some of the principal manufacturers and organizations concerned in the design and sale of motor trucks information as to the present practice and expressions of opinion as to the economical limits of size, weight, speed and loads. Of 221 manufacturers in this country producing commercial vehicles at the beginning of the present year, only 88 are offering trucks of more than 3 tons capacity. Fifty-eight have made no change in their models for 1916, twelve have increased their maximum capacity, six have decreased it and twelve are newcomers in the field. Mr. Lewis has found the popularity of 3½-ton and the 5-ton trucks quite noticeable.

### Probable Maximum Weights and Loads

Six of the largest makers of trucks, one organization dealing with their design and one devoting itself to the promotion of their use have expressed their opinions as to the probable economic limits of weight, load capacity and load on rear axle. The maximum weight of car is estimated at from 10,000 to 12,000 lb., the load capacity at from 10,000 to 16,000 lb. and the load carried on the rear axle at from 16,750 to 24,000 lb. The load per inch width of tire is estimated at from 600 to 800 lb.—a limit that Mr. Lewis has noted appears to have been fixed by the inability of rubber tires to sustain a heavier load, and not by any consideration of the effect of concentrated loads on street pavements. Mr. Lewis thinks there is a very rational basis for the prediction that the maximum limit of weight will be about 6 tons. "A careful analysis," said he, "of the ton-mile cost of moving material by motor trucks indicates that this cost reaches a minimum in the case of a 5-ton truck at a speed of 9 miles an hour, or a 6-ton truck at 8 miles an hour, the estimated cost being 6.88 cents per ton-mile in the former and 6.87 cents in the latter case. The operating cost of a 1-ton truck at 15 miles an hour is estimated to be 11.33 cents, and that of a 10-ton truck at 5 miles an hour to be 7.40 cents per ton-mile. All these estimates are predicated upon 5 hours of actual running during the day."

"Perhaps the most important consideration from the city-planning point of view," continued Mr. Lewis, "is the size of the vehicle, more particularly its width and its flexibility. The manufacturers and others have indicated that the wheel base varies from 12 ft. 6 in. to 17 ft. 4 in., the over-all length from 22 to 28 ft., the gage between centers of tires from 5 ft. 10 in. to 6 ft. 3 in. and the over-all width from 7 ft. 4 in. to 8 ft., the opinion also being expressed that these will be the probable limiting dimensions. . . .

### EFFECT OF WIDE TRUCKS

"If a roadway in which there are no railroad tracks is designed to accommodate four lines of traffic, allowing 8 ft. for each line, which would permit 2 ft. of free space between the great majority of vehicles, and if trucks measuring 8 ft. over all are permitted on public streets this width of 8 ft. for a line of moving vehicles will be insufficient. The roadway capacity will be actually reduced to three lines of traffic, and that means that the street capacity for accommodating vehicles will be reduced almost one-half by reason of the fact that the third or middle strip must accommodate vehicles moving in both directions and the interference will be so great that the capacity of this middle strip will be very small."

Mr. Lewis then quoted several opinions from the motor-truck people to the effect that the city streets must adapt themselves to the development of the motor truck instead of the truck adapting itself to the street. One of them said: "The city street of the future must be wide—very wide—to allow for a line of stationary vehicles near the sidewalk, a line of slow moving vehicles next and a line of fast moving vehicles in the center." Mr. Lewis pointed out, however, that street widenings are very costly, prohibitively so in many cases—even though it is often possible to increase the width of the roadway at the expense of the sidewalk, to eliminate unsightly strips of dirt between the sidewalk and the roadway, or to remove encroachments on the sidewalk. The greatest traffic congestion, he pointed out, commonly occurs on streets where there are costly buildings and where widening is out of the question. For certain points he suggests detours or by-passes, made attractive by means of better pavements and easier grades.

An examination was made by Mr. Lewis into the question of the ability of large trucks to turn corners without fouling traffic in the opposite direction. His conclusion is that the necessity for setting back curb corners has been somewhat overestimated

His inquiries embraced the question of trailers, and some of the responses indicated belief that three trailers might be used, with a total length, including the truck, of 50 ft. It was pointed out that with a suitable coupling trailers would follow the tractor and turn corners without difficulty. Mr. Lewis believes, however, that the number of trailers which may be used in city streets should be limited so that the total length of train should not exceed say, 50 ft., and that special permits should be required for trains as long as this.

### Conclusions

In conclusion Mr. Lewis summarized his views as follows:

1. The effect of the motor vehicle upon the city plan of the future will be beneficial in that it will aid in bringing about some of the most important results that city planners are striving to attain, such as:

(a) The discouragement of further centralization by reason of the fact that distances can more readily be overcome and less time will be consumed by men and women going to and from their work.

(b) The diffusion of land values. While they will be increased in the aggregate, sensational increases in some places and stagnation in others will be less likely, and real estate will be put on a more stable basis.

(c) Insistence upon a better class of street and road improvements, they in turn stimulating better improvement of the abutting property.

(d) A better knowledge on the part of the citizen of his city and its environs, through the more general use of the motor car. He will thus acquire a greater interest in the improvement of both and a more widespread interest in city-wide planning will be developed.

### GREATER SPEED AND FLEXIBILITY OF MOTOR VEHICLE

2. While the amount of traffic on important thoroughfares will be greatly increased, the greater speed and flexibility of the motor vehicle will permit a much greater volume of traffic to be accommodated with safety in the same street, provided:

(a) That the speed and movement of all vehicles are controlled by intelligent police regulations so that the safety of riders and pedestrians shall be protected. This means regulation of pedestrian as well as vehicular movement and the education of both in the principle of "Safety First."

(b) That the width of commercial vehicles is so regulated that the number of lines of traffic which a street can accommodate will not be reduced and the capacity of the roadway thereby seriously curtailed. This might be accomplished by the imposition of a tax or license fee which would be uniform for all vehicles having an over-all width of 7 ft. or less, with an additional tax increasing in geometrical ratio for each inch of width over 7 ft.

(c) That the wheel loads are so restricted that the sustaining power of street pavement and foundation is not exceeded. The most rational way to do this would be to prohibit wheel loads in excess of 700 lb. per inch width of tire, and these only on rubber tires, the maximum loads on steel tires to be less, or say 600 lb. per inch of width.

3. The greatest congestion, delay and danger will be found where the traffic is most mixed. The traffic problem will, therefore, be simplified if heavy manufacturing, business and residences are confined as far as possible to certain well-defined districts. Regulations having this end in view are becoming more generally recognized as an essential part of good city planning.

4. Horse-drawn traffic requires relatively light grades. Motor cars and trucks can overcome much steeper grades and considerable expense can, therefore, be saved in regulating streets, as they can conform more closely to the topography. The greater speed of the motor vehicle will also justify longer detours to avoid excessive grades, and little time will be lost thereby.

### MOTOR VEHICLES MUST ADAPT THEMSELVES TO STREET CONDITIONS

5. While street corners and junctions should be improved wherever possible, manufacturers of motor vehicles should understand that they must adapt their vehicles to street conditions wherever possible, and that they should not be satisfied with present practice and expect the city streets to be adapted to such practice. The mobility of such vehicles, the short turning radius for the heaviest motor trucks, and the ingenuity which has been displayed in the design of trailers which will follow the tractor without the cutting of corners give promise that such adaptation to existing conditions is possible. Every effort should be made to conform with the existing conditions before demands are made for modifications of street details at great cost.

6. With decreasing cost of light motor cars and with the likelihood of cheaper fuel the number of such cars will doubtless continue to increase. The problem of their accommodation in public streets will solve itself with the improvement of the character of road surfaces, although a serious problem will be presented in providing for the accommodation of standing cars. This will undoubtedly require the widening of roadways where possible at the expense of the sidewalks, and the provision at frequent intervals of parking spaces where cars may be left and cared for at a moderate charge.

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## Pennsylvania Orders 130-Pound Rail

An order for more than 100,000 tons of 130-lb. rail has been placed by the Pennsylvania Railroad. The only difference between the new section and the 125-lb. standard adopted by this road some time ago is in the addition of ⅛ in. of metal on the top of the head and 1/32 in. in the thickness of the web. This makes a total height of 6⅝ in., base width of 5½ in., width of head of 3 in., depth of head of 2 in. and web thickness of 11/16 in., as compared with the corresponding figures of 6¾, 6, 2 15/16, 1 27/32 and 21/32 in. for the 130-lb. section of the American Railway Engineering Association. In this connection it may be stated that the web thickness of the Pennsylvania's 125-lb. rail, given as 23/32 in. in the table on page 221 of the Engineering Record of Feb. 12, where the new 136-lb. rail of the Lehigh Valley Railroad was compared with other heavy rails, should have read 21/32 in.

# Levee System Is Expected to Protect Memphis Against Future Floods

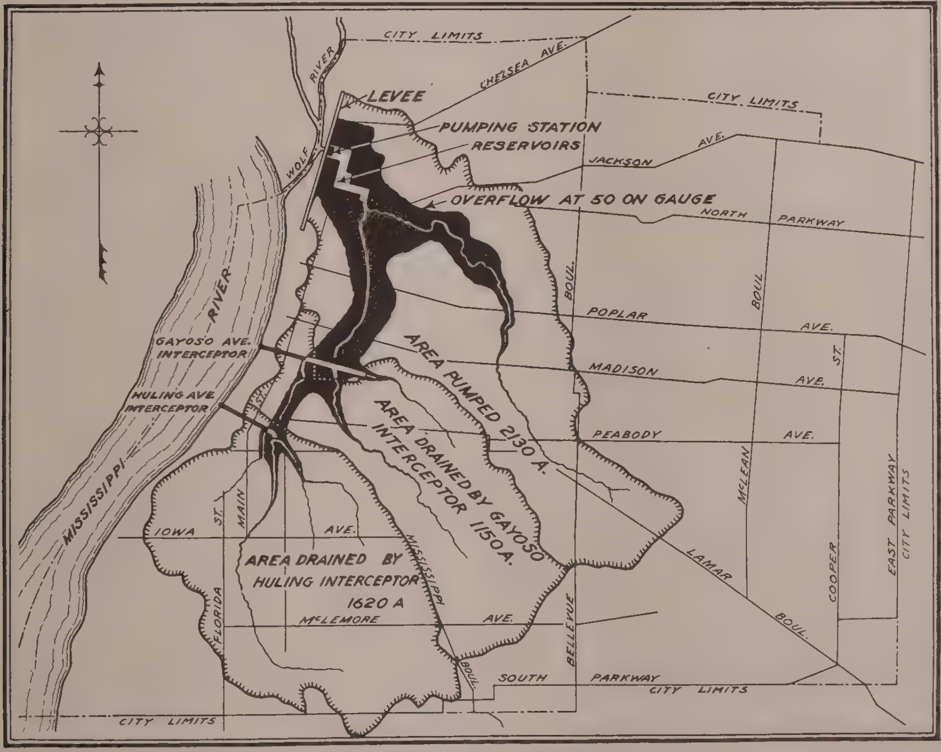
## Pumping Plant and Two Interceptors Leading Through Bluff to River Will Take Care of City's Sewage and Storm Water of Bayou Gayoso

By J. H. WEATHERFORD
City Engineer, Memphis, Tenn.

A LEVEE protecting the city of Memphis against the flood waters of the Mississippi River and its tributary, the Wolf River, which joins the "Father of Waters" at the north city line; a pumping station for disposing of the storm water of Bayou Gayoso—a creek flowing north through the city to the Wolf River—and also the sanitary sewage of the city, and the diversion of such parts of the storm water of the bayou as could be carried at all times by gravity into the river—these are the essential features of what is known as the North Memphis levee system, designed to protect Memphis against floods. The work is planned for a stage several feet higher than that reached in 1913.

### Topography of Memphis

Memphis occupies what is known as the Chickasaw Bluffs on the east bank of the Mississippi River, which bluffs are the western terminus of a ridge of land lying between Wolf River on the north and Nonconnah Creek on the south, that part of the ridge occupied by the city proper being largely from 150 to 200 ft. above low water of the Mississippi River, the crest of the ridge being near the south city limit. A small creek known as Bayou Gayoso traverses the city from south to north along the eastern edge of the main business district, emptying into Wolf River near the north city limits, the banks of this bayou near its mouth being about 35 ft. above low water, or 35 ft. on the gage.



FLOOD AREA ALONG BAYOU GAYOSO PARALLELS THE MISSISSIPPI RIVER

Prior to 1900 the river bed spread over low ground west of the city and did not reach above this stage; about this time, however, as levees were being constructed on the opposite, or Arkansas, side of the river above Memphis, it became increasingly evident that the water confined in the river would reach a higher stage than had ever been reached before. In 1904 a levee system was constructed to confine Bayou Gayoso between banks from its mouth at Front Street and Wolf River east and south along the bayou as far as Poplar Avenue, together with a storm drain for draining the low property back of this levee. This system was satisfactory up to a stage of 41 ft., but early in the spring of 1912 a stage of 45½ ft. was reached, and the water overflowed this low territory.

It was evident then that any plan for leveeing the bayou against such stages was absolutely futile. Steps were therefore taken to prepare a plan which would give protection against a 48-ft. stage on the river. After due consideration it was decided that a 50-ft. stage would probably be reached at some future time and should be provided for, with provision for further additions to protect against even higher stages. The wisdom of this was shown when the floods of 1913 reached 46½ ft. and showed that any year the city might be called on to hold the amount of water which had been figured on in 1912.

### Three Plans Considered

Under direction of the Board of Commissioners the writer, as city engineer, was instructed to prepare plans and make recommendation in regard to same. The general plans considered embraced a number of different methods of handling the work. The first method considered was the raising of all streets to a grade equal to 50 ft. on the Memphis gage. The second was the building of a complete system of storm sewers, including a pressure system, through the entire city, with a pump to handle only such parts of the water as actually fell below a 50-ft. stage, and levees along the east side of Wolf River to keep out the flood water from the Mississippi River. The third was the building of a levee, as in the second plan, the diversion of such part of Bayou Gayoso as could be diverted, and the pumping of such water as could not be diverted.

The first of these plans was abandoned after careful study had been made of the expense of raising the streets and adjoining property, and the expense to individual owners in the low-lying territory. The second plan was also abandoned because of the great cost. The third plan was given very serious consideration and after study extending over a number of months the present plan, designated the North Memphis Levee System, and outlined in the first paragraph, was adopted.

The accompanying map shows the location of the levee and pumping station, the territory which would have been flooded during heavy rains at 50 ft. on the gage and the respective areas the drainage from which is to be pumped and which drains through the two intercepting storm sewers into the river.

### Levee Built for 52-Foot Stage

The levee occupies the right-of-way of the Illinois Central Railroad parallel to and about 200 ft. west of Front Street (600 ft. west of Main Street) and is approximately 6000 ft. long from grade point to grade point, with its top at an elevation of 52 ft. on the gage.

The United States gage used for river elevations is situated practically 1½ miles downstream from the levee site, the normal river slope being practically 0.6 ft. in this distance. The floods of 1912, however, showed a slope of 1.35 ft., and allowance of 1.5 ft. for this slope was used in all calculations. In 1913 the actual slope was 0.95 ft., so that the levee level as established was 52.5 ft. on the 1913 flood records.

Borings along the levee site developed that the entire area was covered by from 3 to 15 ft. of cinders, bark and slabs, and that under this were strata of soft blue river fill, quicksand, yellow clay, yellow sand and blue sand, all resting on an extremely hard blue clay. The levee site was first stripped clear of the cinders, bark, etc., and a line of 35-lb. United States steel sheet piling driven into the underlying blue clay as a cut-off sheeting.

Concrete retaining walls of the counterfort type were built with center of the wall resting on steel piling where it was necessary to prevent the levee from encroaching on private property. These walls varied in height from 14 to 26 ft. Where it was possible to build slopes on the land side a pile every 9 ft. was left extending up to 46 ft. on the gage (6 ft. below levee grade) and a reinforced slab or core wall 12 in. thick built up on these as a frame, there being 540 lin. ft. of this core wall.

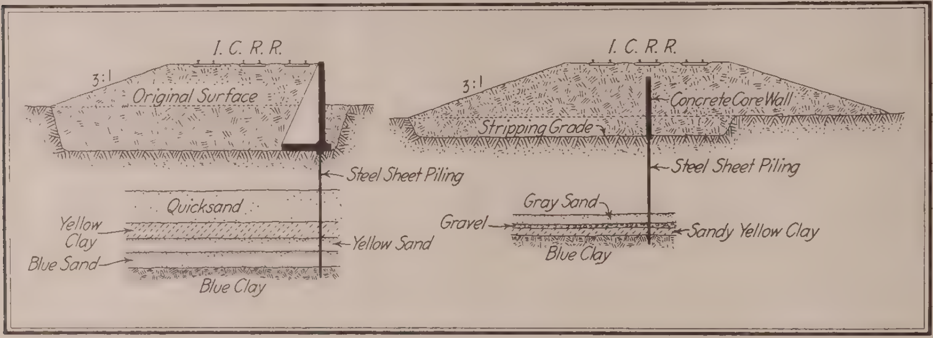
All stripping, sheet piling and concrete walls was done by the city at an expense of $125,000. All earth filling, amounting to 200,000 cu. yd., was placed by the Illinois

Central Railroad, which will occupy the top of the levee with its tracks. The earth levee has a 40-ft. minimum crown, with 3:1 slopes.

### PUMPING PLANT DRAINS 2130 ACRES

The total city area which originally drained through Bayou Gayoso and emptied into Wolf River where the pumping station is now located is 4900 acres. Of this it was feasible to drain 2770 acres directly into the river through two intercepting sewers, known as the Gayoso and the Huling interceptors, leaving an area of 2130 acres draining directly to the pumping station.

A study of rainfall curves showed the run-off from this area to 4160 sec.-ft., equivalent to 2 in. of rain per hour, all running off. This, however, occurs after ordinary periods of high water, so that during high-water periods it is necessary to take care of 1½ in. or approximately 3200 sec.-ft. There were available, however, certain low-lying areas along the bayou which were purchased for use as reservoirs. Taking advantage of these the capacity of the main pumps for the station was fixed at 1200 sec.-ft., which with the reservoir storage should be ample even in the severest storm.



TYPICAL CROSS-SECTIONS OF LEVEE WITH AND WITHOUT RETAINING WALL

In order that the pumping lift might be held as low as possible the old bayou levees were retained, thus making it unnecessary to pump until a stage of 40 ft. is reached, and at the same time reducing the pumping lift, since with these levees and the reservoirs it is not necessary to hold the bayou below 35 ft.

The low territory behind these levees is drained by a storm sewer known as the West Side storm sewer, which leads to the pumping station.

The larger part of the sanitary sewage of the city is handled by a 48-in. main which backs out in this low territory at 34 ft. on the gage. The West Side storm sewer crosses under this sewer at Auction Avenue and Front Street, and a by-pass with a sluice gate has been constructed at that point so that the sanitary sewer may be diverted through the storm sewer to the pumping station. A flood gate has also been constructed to cut the sanitary sewer off from the river.

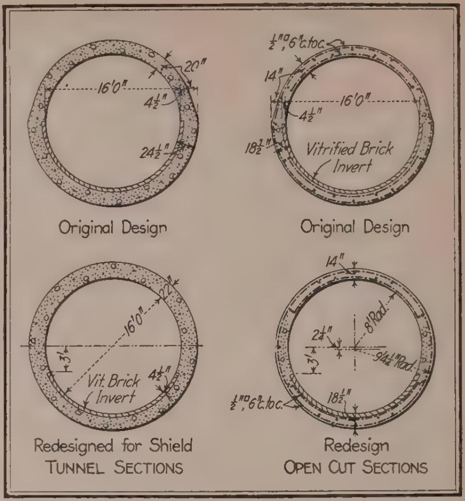
A low-level pumping plant has been provided under the same roof to take care of this water, the capacity of this plant being 160 sec.-ft.

### PUMPING STATION DETAILS

The pumping station is a reinforced-concrete structure, 60 ft. wide, 160 ft. long and 100 ft. high from foundation to top of roof, about half of the structure being below ground. The foundation mat or sump floor is of mass concrete 3½ ft. thick with its top at 6½ ft. on the gage, and rests on 1200 creosoted yellow-pine piles driven to blue clay. The west wall, which forms a part of the levee, is 5 ft. thick at the base, 30 in. thick at floor level and 24 in. at 52 ft. on the gage. Under this wall interlocking steel piles, weighing 35 lb. to the square foot, were driven to blue clay. This wall is pierced by four openings in the main part of the building, each 7½ x 10 ft. These openings are closed during periods of high water by rectangular sluice gates of the same size, which gates are opened during low water to permit the bayou to discharge by gravity.

One of the drawings shows a cross-section of the pumping station, together with the twin box culverts under the levee to Wolf River and the semicircular culvert under Front Street.

The pumping station houses two pumping plants, one of 1200 sec.-ft. capacity, operated at stages of 40 ft. or over, and one of 160 sec.-ft. capacity, operated at stages of 34 ft. or over. The main plant operates under a normal head of 15 ft.; the low-level station under a head of 25 ft. (against a 50-ft. stage), which latter head would have been necessary for the entire station but for the low-level system.



INTERCEPTORS IN TUNNEL AND IN OPEN CUT

The main pumping plant consists of four 72-in. double-suction horizontal-shaft centrifugal pumps—each pump having a normal capacity of 300 sec.-ft. against a head of 15 ft. and each pump driven by a 750-hp. three-phase, 60-cycle, 6250-volt induction motor, with a normal speed of 116 r.p.m.

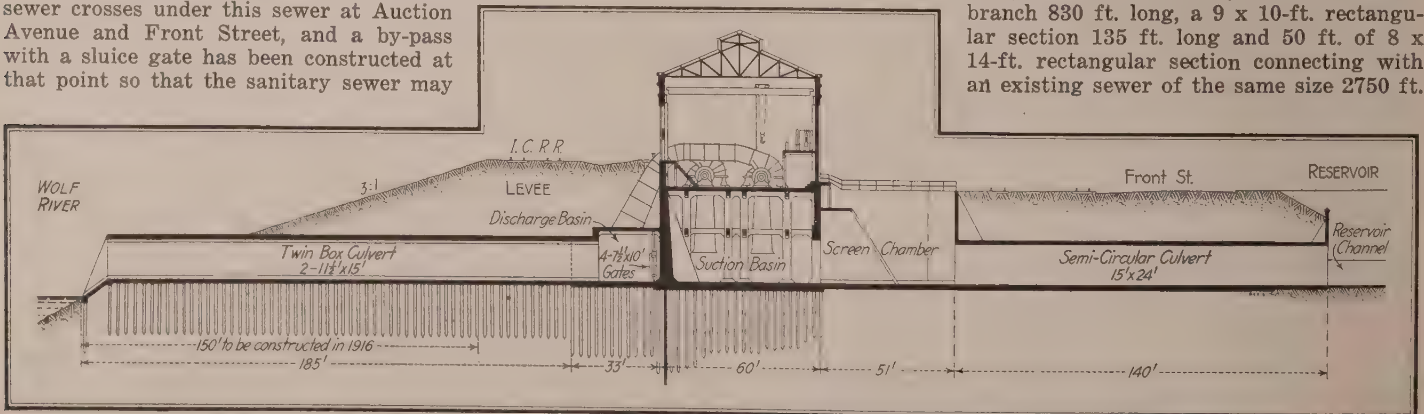
The low-level or West Side storm sewer pumps are in the south end of the buildings, and consist of two 36-in. vertical-shaft centrifugal pumps each of 80 sec.-ft. capacity, and each driven by a 300-hp. induction motor with a speed of 165 r.p.m. controlled from the same platform as the larger pumps.

The pumps and motors were built and installed by the Allis-Chalmers Manufacturing Company, of Milwaukee. The building was erected by the James Alexander Construction Company, local contractors.

### DIVERSION SEWERS OR INTERCEPTORS

Reference to the map will show that the river flows south, whereas Bayou Gayoso flows north almost parallel to the river. It was thus possible to divert the bayou directly through the bluffs into the river where ground levels were sufficiently above high water to permit, and two points were selected for this, each being at the confluence of two or more branch bayous—the interceptors being designated by the names of the streets under which they lie as the Huling interceptor and the Gayoso interceptor.

The Huling interceptor drains 1620 acres and is a circular sewer 16 ft. in diameter extending eastward from the river 1925 ft. along Huling Avenue with an outlet apron or spillway 125 ft. long, an 8-ft. circular branch 830 ft. long, a 9 x 10-ft. rectangular section 135 ft. long and 50 ft. of 8 x 14-ft. rectangular section connecting with an existing sewer of the same size 2750 ft.



PUMPING PLANT DRAINS NEARLY HALF OF FLOOD AREA ALONG BAYOU GAYOSO—INTERCEPTORS DISPOSE OF THE REST long. Cross-sections are shown of the 16-ft. section, part of which was built in tunnel and part in open cut.

### TUNNEL UNDER SEWER

The construction difficulties of this interceptor were increased by reason of a 36-in. sanitary sewer occupying both Second Street and Huling Avenue and crossing from one side to the other of each street. In the laying of grades for the interceptor this was borne in mind, and along Huling Avenue the top grade was put 5 ft. below the flow line of the sanitary sewer. Fortunately the line along Huling Avenue was of cast-iron pipe and stood the test; had it not been of this material no attempt would have been made to use this street.

Work was started at the river end with a shield 20 ft. in diameter and 9 ft. long driven by sixteen hydraulic jacks 6 in. in diameter. Wood cants 4 ft. long of 6 x 8-in. oak, with the outside cut to a 21-ft. circle, were put in to line the excavation and push against. The shield proved too light and was rebuilt, being heavily reinforced, after moving about 100 ft. Construction was again started, but progress was still slow, and after a total of 692 ft. of tunnel had been driven the shield again failed and was abandoned.

During this construction an air pressure of from 5 to 9 lb. was maintained, all excavation being locked out and materials locked in. Serious troubles, however, were encountered with ground water, and the sand in the bottom 3 ft. proved practically a quicksand, the upper part of the excavation, however, proving quite hard. It was therefore decided to attempt to drive the top half of the tunnel by a cap-and-leg method and to concrete the top half. This method proved fairly satisfactory, although some settlement developed owing to the method of timbering, and the balance of the tunnel was thus driven. Two lines of 1-in. square bars were carried continuously in the bottom of the arch walls to strengthen them during the construction of the invert. The bottom half was then constructed without serious trouble.

Grout pumps were used to force grout into all crevices left by the excavation, and in some cases this grout was forced through to the street surface.

The contractor was the Southern Asphalt & Construction Company.

The Gayoso interceptor drains 1150 acres. It is a circular sewer which extends from zero on the Memphis gage east under the center of Gayoso Avenue and through private property to a point 400 ft. east of Wellington Street. It has 275 ft. of special outlet section, 2805 ft. of 15-ft. circular section, and 1155 ft. of 8-ft. circular section with two branches, a 6-ft. rectangular branch built in tunnel and extending south 570 ft., and an 11½ ft. circular section extending south 420 ft. The contractor was the Thomas-Harmon & Hickey Brothers Company.

This sewer extends through territory that is practically at an elevation of 50 ft. on the gage at two points, and all open-cut work was reinforced against internal as well as external pressure. No openings were made into the tunnel below 55 ft. on the gage, and the ends of all sections were carried into territory that was above that grade. The 15-ft. section is of monolithic concrete 20-in. thick in tunnel and of reinforced concrete 12 in. thick in open cut, all with the bottom third brick lined.

Approximately 1900 ft. was built in tunnel by the shield method under an air pressure of about 5 lb. The shield used was 19 ft. 8 in. in diameter and 9 ft. long and was driven by fourteen Watson Stillman hydraulic jacks. Oak cants 6 x 8 in., 4 ft. long, cut to 9 ft. 10 in. radius outside were used for timbering and to jack against. The balance of the 15-ft. section and the 8-ft. and 11½-ft. sections were built in open cut, a Potter trench machine being used on the 8-ft. section and a traveling stiffleg derrick and clamshell bucket on the other sections.

### CONCRETING OF INTERCEPTORS

All concrete on both interceptors was made of Mississippi River "river run" sand and gravel, monolithic concrete being mixed in the proportion of 5 sacks of cement to 1 yd. of sand and gravel and reinforced concrete in the proportion of 6 sacks of cement to 1 yd. of sand and gravel. Vitrified shale brick pavers was used for the brick lining. The open-cut concrete was machine mixed and deposited through chutes, either directly from the mixer or from barrows. The tunnel concrete was placed by the pneumatic method with a mixer made by the Concrete Mixing & Paving Company, of Chicago, the concrete being satisfactorily blown through an 8-in. pipe for a distance of 600 ft. from the mixer. When this distance was reached the mixer was moved up in the completed tunnel and a 10-in. shaft sunk from the surface into the tunnel. The materials were proportioned on the surface of the street and dropped through a door into a lock; the bottom door was then opened and the materials were dropped through the shaft into the mixer. Water was then added and the mix blown by compressed air through an 8-in. pipe directly into the forms and there spread by hand. Blaw steel forms were used almost exclusively on the work.

All plans and specifications for the work were prepared under the direct supervision of the writer and approved by George W. Fuller, consulting engineer, of New York City, with the exception of the plans for the pumps and motors, on which A. B. Wood, of New Orleans, was consulting engineer. The work was carried out under the direction of the writer, with W. A. McTighe, assistant engineer, in charge of construction. The operation of the pumping station will be in charge of Roy Johnson, electrician.

# Literature

For the Civil Engineer and Contractor

## New Publications

DWELLING HOUSES—A CODE OF SUGGESTIONS FOR CONSTRUCTION AND FIRE PROTECTION. Recommended by the National Board of Fire Underwriters. Paper, 6 x 9 in.; 115 pages; illustrated. New York, the National Board of Fire Underwriters, Ira H. Woolson, consulting engineer, 76 William Street.

RULES FOR CONDUCTING PERFORMANCE TESTS OF POWER PLANT APPARATUS. Report of Power Test Committee, American Society of Mechanical Engineers. Paper, 6 x 9 in.; 215 pages; illustrated. New York, American Society of Mechanical Engineers, 29 West Thirty-ninth Street.

SOME FOREIGN SPECIFICATIONS FOR RAILWAY MATERIALS: RAILS, WHEELS, AXLES AND TIRES. By G. K. Burgess, physicist, and P. D. Merica, associate physicist, U. S. Bureau of Standards. Technologic Paper No. 61. Paper, 7 x 10 in.; 132 pages, illustrated.

Part of program relating to the determination of the causes of failure of railway materials. Discusses and compares the several types of foreign specification and tests of rails, wheels, axles and tires, treated by subjects. Some accident statistics are included.

HYDRATED LIME—HISTORY, MANUFACTURE, AND USES IN PLASTER, MORTAR AND CONCRETE. By E. W. Lazell, Ph. D. Paper, 6 x 9 in.; 95 pages; illustrated. Pittsburgh, Hydrated Lime Bureau of the National Lime Manufacturers Association, Arrott Building. 30 cents.

EXPERIMENTS ON THE ECONOMICAL USE OF IRRIGATION WATER IN IDAHO. By Don H. Bark, irrigation engineer, Division of Irrigation Investigations. Bulletin 339, U. S. Department of Agriculture, Office of Public Roads and Rural Engineering. Paper, 6 x 9 in.; 57 pages; illustrated. Washington, Government Printing Office.

SHINGLE ROOFS AS CONFLAGRATION SPREADERS. An appeal to the Civil Authorities and Civic and Commercial Bodies. Paper, 6 x 9 in.; 21 pages; illustrated. New York, National Board of Fire Underwriters, Committee on Fire Prevention, 76 William Street.

PROGRESS IN RECLAMATION OF ARID LANDS IN THE WESTERN UNITED STATES. By J. B. Beadle, U. S. Reclamation Service. From the Smithsonian Report for 1915. Paper, 6 x 9 in.; 21 pages; illustrated. Washington, Government Printing Office.

REPORT OF PROCEEDINGS, TWELFTH ANNUAL MEETING AMERICAN WOOD PRESERVERS' ASSOCIATION, 1916. Paper, 6 x 9 in.; 432 pages; illustrated. Baltimore, F. J. Angier, secretary-treasurer, Mount Royal Station.

REGULATIONS GOVERNING COAL-LAND LEASES IN THE TERRITORY OF ALASKA. Approved May 18, 1916. U. S. Department of the Interior. Paper, 6 x 9 in.; 86 pages; illustrated. Washington, Government Printing Office.

CONCRETE CONSTRUCTION FOR RURAL COMMUNITIES. By Roy A. Seaton, M. S., professor of applied mechanics and machine design, and superintendent of construction, Kansas State Agricultural College. Cloth, 6 x 8 in.; 223 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $2 net.

IRRIGATION DISTRICTS IN CALIFORNIA, 1887-1915. Bulletin No. 2, State of California, Department of Engineering. By Frank Adams. Based on data gathered under co-operative agreement between the Office of Public Roads and Rural Engineering of the United States Department of Agriculture and the California State Department of Engineering. Paper, 5¾ x 8 11/16 in.; 151 pages; illustrated, and contains several sketch maps. California, State Printing Office.

The fifty-seven irrigation districts in California are described as to location, date of organization, area, value and financial status. The pamphlet also includes a review of the Wright irrigation act and its several amendments, with comment on other legal phases of irrigation district organization.

REPORT OF THE CHIEF ENGINEER OF THE BOARD OF ESTIMATE AND APPORTIONMENT, CITY OF NEW YORK, 1914. Paper, 7 x 10 in.; 235 pages; illustrated. New York, Chief Engineer, Board of Estimate, Municipal Building.

## Books Reviewed

### Hydraulic Tables

Author, Joseph H. Harper, formerly of Harper, MacDonald & Company, Butte, Mont. Leather, 4 x 6½ in.; 192 pages; 17 illustrations. New York, D. Van Nostrand Company. $2 net.

REVIEWED BY A. G. HILLBERG

Civil and Hydraulic Engineer, New York City

About three-fourths of this book is devoted to tables giving the flow of water in differently shaped channels under various conditions, calculated by means of formulas generally accepted by engineers as giving the best results. The author has divided the book into seven parts and an appendix. Part 1 is introductory, discussing formulas, coefficients of roughness, methods of interpolating in the tables, and the like. Parts 2 to 5 consist of tables for the flow of water in circular pipes, when running full or under pressure; in rectangular open channels or timber flumes; in open trapezoidal channels, ditches and canals; and in egg-shaped conduits, when running full, two-thirds full and one-third full. These tables cover an unusually large range of values, and by straight-line interpolation any desired intermediate values can be obtained.

In Part 6 the author has grouped miscellaneous information and reference tables. The hydraulic units, acre foot and miner's inch have been explained and conversion tables given. The other subjects dealt with are weight or static pressure in fluids, buoyancy, discharge through orifices, measurement of water and the various types of weirs used, tables giving heads and corresponding discharges, and limiting velocities in various kinds of conduits. Part 7 contains discussions of the various formulas, and the appendix consists of tables and charts comparing the various formulas used.

The author has succeeded in compiling a very useful little handbook that will be welcomed not only by office engineers engaged in designing but also by field engineers called upon to determine quickly the quantity of water carried in conduits or discharged over weirs.

## The Panama Canal

A Series of Papers Covering in Full Detail the Technical Problems Involved in the Construction of the Canal. Prepared by engineers and other specialists in charge of various branches of the work and presented at the International Engineering Congress, 1915, under the direction of George W. Goethals, major general, U. S. Army, Governor of the Canal Zone. 2 volumes, 25 Papers. Cloth, 6 x 9 in.; 527 and 483 pages respectively; illustrated New York, McGraw-Hill Book Company, Inc. $7.50 net per set.

This exhaustive treatise is the most authoritative and exact technical exposition of the many correlated tasks accomplished in the monumental work of digging the Panama Canal which is now available. The wide general interest and scope of these tasks is suggested by the fact that, in addition to the more specialized papers covering the engineering work involved, there is also included a general historical and statistical introduction by the present Governor of the Canal Zone, Major-General George W. Goethals, under whose direction these papers were prepared; the commercial and trade aspects of the canal, by Emory R. Johnson; an outline of Canal Zone geology, by Donald F. McDonald; sanitation in the Canal Zone, by Charles F. Mason; preliminary municipal engineering at Panama, by Henry Welles Durham; municipal engineering and domestic water supply in the Canal Zone, by George M. Wells; the working force, by R. E. Wood; the purchase of supplies, by F. C. Boggs; climatology and hydrology of the canal, by F. D. Willson; terminal works, dry docks and wharves, by H. H. Rousseau; coaling plants and floating cranes, by F. H. Cooke, and aids to navigation for the canal, by Walter F. Beyer.

The papers treating the details of the actual work of constructing the canal were written by men in charge, and cover the whole range of engineering problems involved from dry excavation, by Major-General Goethals himself, to the reconstruction of the Panama Railroad, by Frederick Mears. Among the technically more important of these papers may be mentioned the construction of the Gatun locks, dam and spillway, by W. L. Sibert; dredging the canal, by W. G. Comber; the general design of the locks, dams and regulating works, by H. F. Hodges; the design of the spillways, by Edward C. Sherman; the design of the lock walls and valves, by L. D. Cornish; lock gates, chain fenders and lock entrance caissons, by Henry Goldmark, and the emergency dams above the locks, by T. B. Mönniche.

The work of the publishers is uniformly excellent, both volumes containing a wealth of illustrations reproduced from photographs and drawings. Such books as these should be in the library of every engineer who has a real interest in the monumental achievements of his profession.

# Letters to the Editor

*Comment on matters of interest to engineers and contractors will be welcomed*

## Who Must Pay for the Transit?

SIR:—The inquiry of the Pennsylvania engineer in your issue of May 13, page 653, as to whether he could compel payment for damage to a transit knocked over in a city street by a man driving against it, reminds me of a similar experience in the city of St. Albans, Vt., where we, when making surveys for a city sewer system, had a transit upset by a team driven by an intoxicated citizen. It cost upward of $40 to repair the instrument, and acting on the advice of the mayor of the city we placed the claim in the hands of the city solicitor for collection. This public official settled with the person doing the damage for $30 and retained $15 of this amount for his services in effecting the settlement.

ARTHUR W. DUDLEY.

Manchester, N. H.

## Final Report of Construction of Los Angeles Aqueduct

SIR: For nearly two years the Los Angeles Board of Public Service Commissioners has had in the course of preparation the "Final Report of the Construction of the Los Angeles Aqueduct," which is now complete and the contract for the printing of which has been let.

It is not possible within this short space to enumerate the different subjects which the volume discusses, but it is sufficient to say that we believe the book will not only serve almost as a text to students but will be an invaluable book of reference to every engineer, contractor or other person having to do with large construction enterprises. What commends the volume is that it contains nothing of theory but is an exposition of the methods adopted by practical engineers in the working out of many problems for which, at the time the work was started, few data were available. There are chapters on municipal tufa cement manufacture, dam building, conduit excavation and lining, tunnel boring in hard rock and in shale, the bonus system as applied to tunnels, steel pipe fabrication, sanitation of water supply, cost keeping, etc., and scattered frequently throughout the book are cost data on all the various classes of work.

The size of the book will be 8½x11. It will comprise about 350 pages, in stout library binding, and will be illustrated by sixty-two full-page and twenty-four half-page halftones and thirty-four line cuts of engineering designs. It will be apparent that entirely aside from the collection and placing in manuscript form of the material, the cost of paper and printer's ink would forbid free distribution. We believe, however, that there will be a large demand for this volume and that it will contribute largely to the benefit of the engineering profession. To this end the board has set a price at which it can be obtained of $1.95 delivered. This price is, exclusive of postage and packing on a weight of 5 lb., under the cost of printing. The board of Public Service Commissioners is not in the publishing business. Instead of deriving a profit it compounds a loss by the sale of the volume. Its interest in the book's distribution extends no further than as above stated.

The only requirement insisted upon will be that the sum stated must accompany the order and the order must be mailed immediately, as only the number of copies will be ordered printed for which orders have been received at the time of going to press. Checks should be made payable to the Los Angeles Department of Public Service, 645 South Olive Street, Los Angeles, Cal.

R. F. DEL VALLE,
President, Board of Public Service Commissioners.
Los Angeles.

## Test of Mushroom Flat Slab

SIR: There appeared on page 647 of the Engineering Record of May 13 an article by D. E. Hooker on "Test of Mushroom Flat Slab in Seattle Warehouse," with editorial comment on page 630 of the same issue.

I was not astonished at the contents, or rather the lack of contents, in the article, because the author's attitude toward the building is familiar to me, but the editorial was a surprise until I reflected that the profession of Mr. Hooker and the public position he occupies justified the editor in assuming that the essential facts had been fully stated.

The two chief facts either not emphasized or not supplied by Mr. Hooker, and concerning which there is no dispute, are: (1) The designers had nothing to do with the erection of the building; (2) the reinforcing steel in the slabs was not placed in accordance with the design. A third point, which will not be designated a fact, although I believe it to be such, is the uncured state of the concrete at the time of the test. The concrete was 116 days old, but because of adverse weather conditions had not reached, in the judgment of the designers, its normal strength. Some fair-minded engineers do not concede that the concrete was not in first-class condition and hence no effort will be made herein to accentuate this phase of the controversy, especially as time has eliminated the defect and it will not be a factor in the second test which the superintendent of buildings has repeatedly promised to make, but does not make.

That there is foundation for the contention that the concrete had not attained the strength ordinarily expected at the end of 116 days is proved by the subsequent behavior of the floor slabs. The floor carried a live load of from 420 to 430 lb. per square foot all last winter, and notwithstanding the misplacement of the steel reinforcement there was not the slightest indication, by cracks or otherwise, of undue stresses.

### REINFORCING STEEL MISPLACED

The misplacement of the steel, where it has occurred, cannot be corrected and will be a vital factor in interpreting the results of future tests of the building. When the floor-slab tests of April, 1915, were being conducted it became apparent that there was something wrong with the wall panels; a few rough measurements disclosed the misplacement of the steel. A survey was requested, but the men in charge of the test refused on the plea that they were not interested in anything but deformation measurements. Mr. Turner then employed a disinterested local engineer, Climie E. Hill, to make a survey of the steel, and subsequently the owner made one. The two surveys are in substantial agreement; the determinations by the owner indicate a slightly greater misplacement.

The Hill measurements will be cited in this letter. The reinforcing steel over column 79 was found to be within 9/16 in. of the correct position, but the inner ring rod, column 80, which fixed the position of *all* the belt rods running to that column, was greatly out of place, both horizontally and vertically; the top of the rod was designed to be 8 in. above the bottom of the slab; its average height was found to be only 5 1/16 in.—an error in construction of 37 per cent. The position of the steel over the other columns is unknown. Is it remarkable that the two wall panels showed weakness, and is it not eminently unfair in an engineer to write upon the results of the test without specifically calling attention to the degree of misplacement of the steel?

The official report of the test by Professors Fuller and More did not contain a suitable reference to the actual position of the steel reinforcement; it was a report by technical men upon the strength of a structural member without stating the actual dimensions of that member. The professors in a revision of the report for a paper read before the Pacific Northwest Society of Engineers Feb. 9, 1916, did incorporate this paragraph: "Attention is called to the location of the inner ring rod near column 80, the designed position of which is 8 in. from top of rod to bottom of slab. The actual distances are as follows: North end about 4½ in.; at center line between columns, about 5¾ in.; south end, about 4⅝ in. At the center line between columns the rod is about 2 ft. 3 in. from the inside of the wall, where the plans show it about 3 ft. 0 in."

Mr. Hooker has persistently avoided stating the whole truth except when forced to categorically answer yes or no. A fair sample of his dodging of the issue is shown in the paragraph at the bottom of the third column, page 648, which contains the only reference to the misplacement of steel, reading as follows: "The center rod carries a greater stress than the others in the interior panel and a lesser one in the wall panel. As this rod was directly under an aisle, it seems natural that it should be somewhat relieved. The survey of the steel shows this rod to be misplaced in the wall panels and over column 79. This may account in part for the apparent discrepancy, and—also possibly for a portion of the excessive stress at the point near wall column 80."

When the tapered plugs were set no precautions were taken regarding the steel. The only defense made for the omission is the assertion that the placing of steel for the mushroom system is more difficult in the wall columns than in the interior ones, also the dogmatic proposition that a design must shoulder the responsibility of errors in construction!

There is an opportunity for a legitimate difference of opinion regarding the relative merits of the various flat-slab systems. As engineers we should be concerned in ascertaining the real truth, but definite conclusions never will be reached unless investigators in reporting the results of tests rise above prejudice and are precise in the statement of all the facts.

A. O. POWELL,
Consulting Civil Engineer.
Seattle.

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SIR: In the discussion of the test of the Bell Street Warehouse, Seattle, presented by Captain A. O. Powell and by Mr. Fixen in the *Proceedings* of the Pacific Northwest Society of Engineers, Vol. 14, No. 1, are given statements of facts as to the uncured condition of the concrete, in conjunction with the misplacement of the steel, quite sufficient to account for the wide divergence between the results of this premature test at Seattle, and the uniform results of scores of others made on well-cured floors of the same design, a divergence which amounts to 100 per cent or more.

In the light of this accumulation of concurrent test data and experience the reported results cannot be seriously considered as any indication whatever as to what the deportment of this same floor would be in its present cured state. The only legitimate conclusion to be drawn from the test is the inexperience and incompetence of those in charge of the test in face of the protest that the slab was in an uncured condition as reported on after investigation by Mr. Fixen, the personal representative of the writer.

The writer feels that he has been unfairly treated by those who made this test, and that a second test of this floor will clearly bring out this fact and make patent the pseudo-scientific character of the published investigation.

This test was paid for by the writer under a rigid stipulation and a written promise or guarantee of the department of buildings that it should be made only when the concrete was thoroughly cured and dried out. This stipulation was not adhered to, and the labored effort to give publicity to a comparison of a test on partly cured work with results on cured concrete are not fair to the designer, Captain Powell, nor to the writer, who reported on Captain Powell's design.

Having contributed more than $1,000 under an agreement that the test made should be made on thoroughly cured work, and since by reason of the inexperience of the investigators this condition was not given business-like consideration, and since the second test has not been made as promised, in order to test the good faith of the parties concerned I will make the following proposition:

I will agree to put up a guarantee of a second $1,000 under condition that a second test on the now cured work be executed in a business-like manner and the conclusions I have condemned as false or erroneous be either substantiated or refuted. If the published results are refuted no money is to be paid over.

C. A. P. TURNER,
Consulting Engineer.
Minneapolis.

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[Captain Powell's letter was referred to Mr. Hooker, whose reply follows.—EDITOR.]

SIR: Mr. Powell's comment on my article pertaining to the test of the Seattle Port Commission warehouse would, I am sure, have been considerably different had all of the article been printed as submitted. Judging alone by the article as it appeared, Mr. Powell would be justified in alleging that I was unfair in reporting the results of the test, for the account as printed did not contain all the essential facts pertaining thereto.

However, the manuscript of the article as submitted did contain all the essential data included in the official report made by Professors Fuller and More to the Seattle building department. In my letter to you with which I transmitted the manuscript of the article in question, I made this specific statement:

"Because this account emanates from an official source, it has been confined to a mere statement of facts taken from the official Seattle building department records, and does not contain any personal views or conclusions of the author."

In order to avoid being accused of the very thing Mr. Powell seems to think me guilty of, I studiously avoided the inclusion of any personal views, conclusions or amplifications whatsoever, and confined myself absolutely to a mere statement of all essential data contained in the official report of the test.

As to the position of the steel reinforcement, I wish to state that the manuscript contained a table giving the exact position of the reinforcing rods at each gage line where deformation measurements were taken. Furthermore, the manuscript included the structural details of the slab, including those of the wall column, which latter accounted for and made possible the misplacement of the slab rods. These details of construction also gave the designed position of the reinforcement.

The paragraph which Mr. Powell cites as being a fair sample of my "dodging of the issue" is, as a matter of fact, a verbatim quotation from the official report of the test and is, therefore, not my language.

A fact which should have been mentioned in my article, and which was omitted unintentionally, is that the Seattle building department has promised Messrs. Turner and Powell that a second test of the building will be made if loading material and necessary funds can be obtained.

I will esteem it a favor if you will kindly corroborate the statements made above relative to my manuscript as submitted.

D. E. HOOKER,
Assistant Superintendent, Seattle Building Department.
Seattle.

[Practical limitations in reproducing drawings for Mr. Hooker's article made it necessary to omit the gage numbers and the table giving position of steel which was included in the manuscript. Editorial comment will be found on another page—EDITOR.]

## Service of Engineering Societies

SIR: I read with great interest the letter by Prof. F. H. Newell in the Engineering Record of May 6, page 620. The opening phrase, "A society exists to render service to its members," certainly is a valuable one, and I agree that it might be wise to display this on the walls of meeting rooms of every society, but I do not think that it goes far enough. Accompanying such a phrase should be another: "As a member of this society I must assist in rendering service to its members."

The larger a society becomes the more unwieldy it is certain to be. There is no reason why the answer to this problem cannot be taken from commercial life. How does any large business organization similar to the packing companies care for its widespread interests? Is there any reason why the engineering society cannot apply similar business methods to its problems?

In trying to solve the economic problems of the engineering profession a newly formed engineering organization has undertaken its work on this basis, and it contemplates the adoption of those business methods in its work which have proved successful in the commercial world, just as quickly as its membership in any community is sufficiently large to warrant the undertaking of the work. There are ideas of common interest to all classes of engineers which one organization can no doubt take care of with greater economy than if the organization of each class of engineers attempts to perform this service for its specific class of engineers. While the three older societies at present have an established overhead and have branches in many cities, neither of them is equipped to care for the work of any of the others.

It has been asserted that the American Society of Civil Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers could appoint committees from each to form a co-operative committee to carry on the work which is common to them, but to do so would call for the establishment of an entirely new set of overhead. As a matter of fact it is not clear to the writer how such a committee could be formed without its becoming the equivalent to the new society, the American Association of Engineers. Furthermore, if such a co-operative committee were formed it could do no more work in securing new members without considerable confusion, and one of the great needs of the engineering profession would not be met—that of interesting the "non-joining" type of engineer in co-operative work. At present there are three of this type to every two who have allied themselves to engineering associations, and it is believed that no lasting benefits can be derived through associations until a very large percentage of all engineers have been interested in studying the social and business problems of present-day engineering.

One plan of action was suggested at the meeting of the committee on co-operation held in Chicago April 13 and 14 which might be worthy of the consideration of all engineering societies. It is that all engineering societies co-operate to evolve a plan whereby certain work is assigned to certain societies and all work on subjects of common interest to all engineers be referred to one society, which might thus become a binder of all engineering societies to care for those matters of common interest. The expense of such action might be prorated between the various societies according to the work to be done by each.

The rapid growth of the new association and the ease with which it has convinced engineers of both the employing and employee type of its soundness and fairness, and the acquisition of a large percentage of engineers hitherto not affiliated indicates clearly that this association has found a field of labor which is distinctively different from that of any other engineering society in the field at present.

ARTHUR KNEISEL.

Chicago.

## Present-Day College Education

SIR: The writer was very much interested in the discussion between Professors Mead and Swain as to whether the present-day college education produces accuracy and thoroughness which appeared in your issue of May 6, 1916, page 607, and his experience with the young technical graduate leads him to agree completely with Professor Swain's summation. A recent incident, which is not infrequent, but which fairly well illustrates the lack of thoroughness and accuracy in the average finished product of our technical schools, appears to fit in very well with this argument.

At a recent civil service examination for paving inspectors taken by some young men about to graduate from the university with which Professor Mead is connected the examiner desired to test the applicants' ability to interpret specifications in a common sense and accurate manner. Not having a set of specifications at hand he picked out a paragraph in the daily paper concerning the trouble on the Mexican border, in which the word "pacificist" occurred. Upon being asked to define verbally the meaning of the word "pacificist" one of the four near graduates unhesitatingly replied that it referred to a certain type of people living along the Pacific Coast. When asked to name the border states another near graduate named North Dakota, Montana, Missouri and Texas, and this question was asked in connection with the paragraph alluded to.

Certainly these young men had not attained that thoroughness and accuracy in their college education which fitted them to fill satisfactorily the simplest engineering position. They were not taught to think straight.

The writer has recently engaged some twenty young graduates from the three leading universities in this vicinity. Before doing so he received letters of application from many times that number. A careful perusal of these letters substantiates Professor Mead's assertion that the teaching of English is neglected; that the writer passed by those applicants whose letters showed a deficiency in English further substantiates the professor's statement that English is an essential necessary to professional preferment.

The writer is aware that an engineer cannot be turned out of the universities in four years, but he is quite sure that after fourteen years of efficient training the English language should be fairly well learned by the average lad, who begins it at the age of ten and continues it through his entire scholastic life. Is it possible that the entrance examinations for the university are deficient in English, and that the instructors attach to it too little importance? If so they have the wrong viewpoint as to the attitude an employer of engineering services takes toward an applicant who can neither speak nor write English reasonably well.

A graduate engineer is expected to write his thesis either before or soon after his graduation. The writer believes he should be required to write one upon some subject every week of his four years' term, and that particular care should be taken by his instructors in marking his composition and his ability to express himself logically.

The much dreaded weekly composition of ancient days should be revived and carried to the end of the senior year. The declamation would be quite as useful a requirement to the engineer as to the law student. These two arts would do more than abstract mathematics to bring the engineering profession to the place in the public's esteem which it deserves.

T. CHALKLEY HATTON,
Chief Engineer, Milwaukee Sewerage Commission.
Milwaukee.

## Medieval Revival in Warfare

SIR: I have just been reading, in the *Literary Digest*, a review of your editorial on "Medieval Revival in Warfare." (See the Engineering Record of April 15, page 503.) In it you are quoted as saying that the bow has not been used in the present European war. It will interest you, I think, to learn that this weapon has been used to a considerable extent.

When the war first started and the British forces began to dig trenches that were less than 150 yd. (a bow shot) from the enemy, I mentioned, in a letter to James Izzard of the firm of Thomas Aldred, of London, that arrows could be made with little bombs fastened to their ends for use in the trenches. Some time later I received a letter from Mr. Izzard in which he said that he had made two dozen arrows of that sort, to which dynamite bombs about an inch in diameter were to be fastened by means of two wires, and that he had sent them to a British officer of his acquaintance who was an archer. What use was made of this "artillery" (in the original meaning of that word) I do not know.

It is definitely known, however, that bows and arrows were used in Flanders for shooting messages across the border. In fact James Duff, of Jersey City, president of the National Archery Association, says that one of these arrows accidentally pierced a man's neck. The Flemish workmen are nearly all enthusiastic archers. I have talked to many of them, have seen them shoot, and have shot with their bows, which are usually of exquisite workmanship.

I do not agree with you in your conjecture that the bow could be successfully used in repelling a night attack. The trouble is that an arrow has so little shocking force that a man could be hit in a non-vital part and yet pull the shaft out and keep on coming. Furthermore, the bow takes rather long to load and fire, especially in the dark.

ROBERT P. ELMER,
Champion Archer of the United States.
Wayne, Pa.

# HINTS FOR THE CONTRACTOR

## Details Which Save Time and Labor on Construction Work

*Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents*

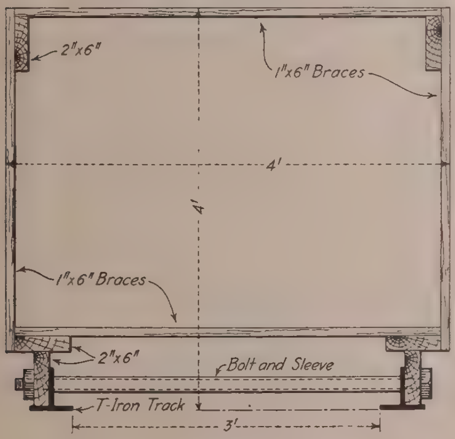
[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

### Portable Towers Save Large Spouting Installation on Viaduct

By R. C. HARDMAN
Colorado Springs, Col.

SMALL, light towers which were easily erected, dismantled and moved, were used recently on a viaduct 750 ft. long, of light construction and with a comparatively small yardage of concrete, where the expenditure necessary for a central mixing and distributing plant was not warranted. The cost of a central distributing plant, exclusive of the tower, was found to amount to 50 cents per cu. yd. of concrete.

Four suitable locations along the viaduct were selected from which almost the entire structure could be reached with 55-ft. towers. These towers, two of which were provided, were moved by being torn down and re-erected, as the configuration of the ground made it impossible to use a tower that could be moved erect. A cross-section of the tower is shown in the accompanying sketch. As the Wallace-Lindesmith hoist, which runs on a track outside of the tower, was used, it was only necessary to make the framework 4 ft. square. The bolts and spacers between the T-beam rails for the buckets were spaced 3 to 4 ft. apart. Guys were attached to the headframe at the top, which carried two sheaves.



LIGHT TOWER EASILY MOVED

By having two towers, and having one ready in the next location before the one in use was through work, only one hoist, with headframe, track and bucket, was needed. This part of the equipment could be moved in a very short time. Although the towers were used twice in each of the four locations, each removal cost only $25 to $30, and the small amount of lumber required kept the total cost below what would have been necessary for a high central tower. The cost of chutes was reduced to one-fortieth of the cost for a central plant. The total cost of the plant came to about one-fourth of the quotations made for furnishing a central distributing system, exclusive of tower. Neither, in the opinion of the writer, was the cost of placing the concrete increased by this method.

### Suggestions for Economical Road Construction

THE USE of an industrial railway in road construction is an economy only under certain conditions in rough grading or in hauling material. In most cases it is economy to complete all culverts as far in advance as possible, and it is of vital importance that material and labor be on hand when the excavation for the culvert is complete. A slight relocation of culverts for small flows is a decided advantage and can be frequently made. The concrete can be put in place rapidly and successfully without the expense of diverting the water. In subgrading contractors often do not trim their rough grading sufficiently close to avoid an excessive cost for cutting the subgrade. Bids ranging from 2 to 5 cents for subgrade are common, with an actual cost of from 5 to 10 cents.

These points were brought out in an address made by Dr. L. I. Hewes, engineer of the federal office of public roads, at this year's Good Roads Week at Cornell University. Dr. Hewes also suggested that the item of hauling and placing of road material be studied carefully before a job is commenced. Such matters may often decide the question of profit or loss on a highway job. It has been found in many cases that while motor trucks and tractor trains are of advantage where good roads prevail, the expense for repairs and lost time under adverse conditions cancels the advantages of speed and capacity.

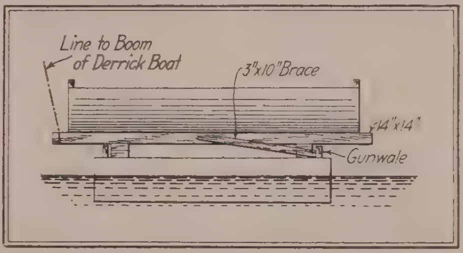
Contractors will find it economical in many cases to deliver stone in piles along the roadbed in advance of the construction of the surface. There exist sufficient data for determining in advance the tonnage of stones of various kinds, spread to various depths, per 100 ft. of road, but because this part of the job is left to guesswork, loss and confusion have often resulted on road contracts. It is an advantage to avoid hauling second-coat material over gravel or macadam foundation.

Machinery should be adapted to the work required. Crushers, for instance, are often used which have a daily output in excess of the roller capacity, and crushers are sometimes purchased which require more power than the engines already owned can develop.

### Derrick Boat Hulls Built Afloat and Launched from Barge

By GEORGE W. MacALPIN
Junior Engineer, Ohio River Dam No. 35, New Richmond, Ohio

THREE NEW derrick boat hulls were constructed resting upon barges and launched from these into the river during April of this year at dam No. 35 on the Ohio River. This process greatly simplified the construction of the hulls, as the material was brought to the site loaded on barges and placed by two derrick boats stationed alongside.



LAUNCHWAYS BRACED TO GUNWALE

A deck barge, 26 x 80 ft., was used for the purpose. Three 14 x 14-in. 35-ft. timbers were placed across it and blocked up to keep them above the gunwales. The new hulls were built in turn resting directly on these timbers. They measured 32 x 72 ft., 62 in. deep, and were finished complete, except for the decking, before launching.

When a hull was ready to launch the cross timbers under it were braced to the gunwale of the barge to prevent their slipping and given a thick layer of grease.

DERRICK BOAT HULL SLID EASILY INTO RIVER BY TIPPING BARGE UNDERNEATH

Water was then pumped into the barge with two siphons until the deck came within 2 ft. of the surface of the river. Each of the two derrick boats then took hold of the inner end of one of the runway timbers. By taking a strain on these lines the barge was tipped, allowing the water in the hold to rush to one side. Increasing this strain, the barge and runways were tipped to an angle of about 30 deg., at which point the derrick boat hull slid off into the river. So easily was this done that although the hulls were not decked no water was shipped during the launchings.

The derrick boat hulls were built by the contractors, the National Contract Company, for use in constructing the dam.

## Accounting for the Contractor—The Columnar Journal

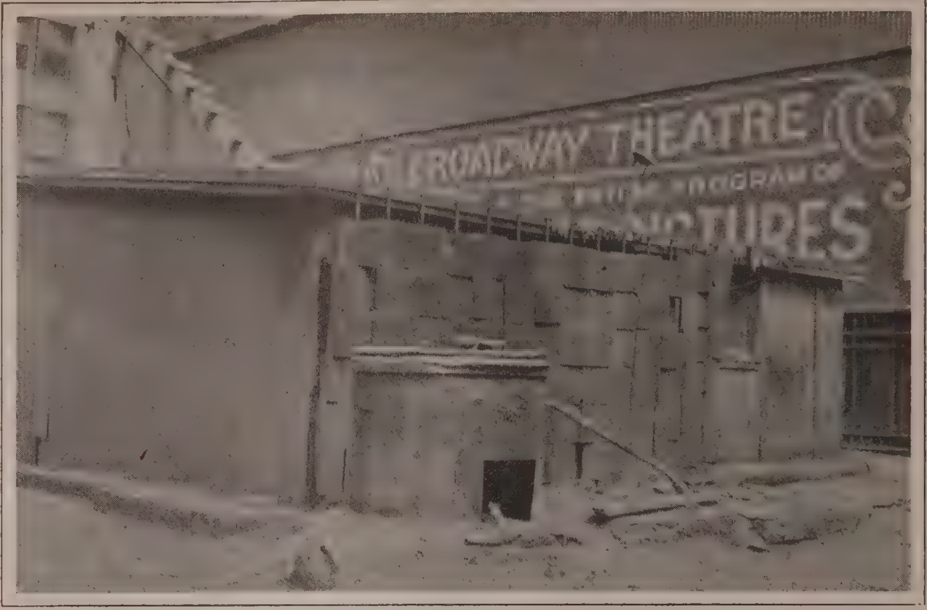
By BENJAMIN L. LATHROP
Lathrop, Shea & Henwood Company,
Scranton, Pa.

AS SUGGESTED in an earlier article, small concerns may dispense with a journal; but assuming that the business shows a normal, healthy growth, it will doubtless be found expedient to adopt a journal, a book which serves as a sort of miniature clearing house for the many and various items which will come into the general office for entry and distribution. The journal serves to index the invoice file, may be utilized to carry information that would otherwise have to be entered in a day-book, and minimizes the number of entries to be carried into the ledger. An ordinary journal contains but two columns for dollars and cents—one for debits, the other for credits. A much more serviceable book for the contractor is the columnar journal. This should contain at least ten columns for figures. Most first-class office stationers carry such a book in stock, or it may pay you to have one made to order, with special rulings to meet the requirements of your business. Consider the time saved in posting to the ledger. A condensed specimen page, starting with the entry of Calvin & Co.'s bills mentioned in the article on invoices published in this section on May 27, is shown herewith. Only seven columns are shown, to save space.

Normally, of course, the entries for a month would occupy several pages, the totals being carried forward from the foot of each page to the top of the next; but the matter is condensed here in order to show the method of closing the journal at the end of the month. Note that the only items requiring daily posting are those that appear in the sundries columns. All the others are posted "in a lump" at the end of the month. The economy of time is much more evident in actual practice than would appear from this abbreviated example, in which an attempt is made to show a comparatively wide variety of entries.

Note the implied suggestion that a ledger account be kept with each monthly payroll. It will be seen that in the foregoing there is an apparent balance of $475.50 due on the "Leeds December payroll." It is assumed that this balance will be covered under an entry from the cash book or check register.

| | | Dr. | | | | | | Cr. |
|---|---|---|---|---|---|---|---|---|
| | | Leeds | Corfu | Br. No. 4 | N. H. Arch | St. Rd. | Sundries | Sundries |
| 1916 Jan. 2 | Sundries | $18.00 | $6.50 | $40.00 | $24.00 | $3.00 | .... | .... |
| | General expense | .... | .... | .... | .... | .... | $18.00 | .... |
| | To Calvin & Co., Dec. | .... | .... | .... | .... | .... | .... | $109.50 |
| 4 | Sundries | .... | 4.00 | 4.00 | .... | .... | .... | .... |
| | To Edward F. Fraser, Dec. | .... | .... | .... | .... | .... | .... | $8.00 |
| 6 | General office expense | .... | .... | .... | .... | .... | 10.00 | .... |
| | To G. H. Ingersoll, Nov. | .... | .... | .... | .... | .... | .... | 10.00 |
| 18 | Sundries | 3.00 | 4.20 | .... | .... | .... | .... | .... |
| | To Jones, Kipp & Lane, Dec. | .... | .... | .... | .... | .... | .... | 7.20 |
| 20 | Leeds Dec. payroll | .... | .... | .... | .... | .... | 325.00 | .... |
| | To M. Perri, Dec. (comissary) | .... | .... | .... | .... | .... | .... | 102.00 |
| | To R. Sanders, agent (cash advanced) | .... | .... | .... | .... | .... | .... | 203.00 |
| | To Leeds shanty (rent) | .... | .... | .... | .... | .... | .... | 20.00 |
| | Leeds | 800.50 | .... | .... | .... | .... | .... | .... |
| | To Leeds Dec. payroll | .... | .... | .... | .... | .... | .... | 800.50 |
| 23 | Leeds Mfg. Co., Dec. | .... | .... | .... | .... | .... | 1,080.00 | .... |
| | Leeds reserve | .... | .... | .... | .... | .... | 120.00 | .... |
| | To Leeds (estimate) | .... | .... | .... | .... | .... | .... | 1,200.00 |
| 28 | Leeds | 250.00 | .... | .... | .... | .... | .... | .... |
| | To Portland R. R. Co. (freight) | .... | .... | .... | .... | .... | .... | 250.00 |
| 31 | Leeds | $1,071.50 | .... | .... | .... | .... | 1,071.50 | .... |
| | Corfu | | $14.70 | .... | .... | .... | 14.70 | .... |
| | Bridge No. 4 | | | $44.00 | .... | .... | 44.00 | .... |
| | North Hill Arch | | | | $24.00 | .... | 24.00 | .... |
| | State Road | | | | | $3.00 | 3.00 | .... |
| | | | | | | | $2,710.20 | $2,710.20 |



TILE STRUNG ON REINFORCING RODS PROTECTS HOIST HOUSE FROM "TAR KETTLES"

## Tile Strung on Reinforcing Rods "Fireproofs" Hoist House

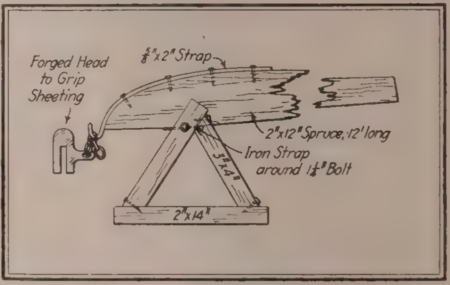
VITRIFIED tile strung on reinforcing rods has been furnishing an economical protection against scorching to the back of the hoist house on the new Seventh Avenue subway just below Forty-first Street in New York City. While waterproofing the subway structure at this point it was found desirable to set the three large tar kettles needed to melt the waterproofing against the back of this house. To protect it from being scorched and possibly catching fire some of the vitrified tile blocks, which are being used on this section of the new subway to back the waterproofing instead of the 4-in. of outside concrete usually employed, were threaded on reinforcing rods. The rods were then stood up against the hoist house at the right intervals and nailed to the eaves. Both the rods and the tile will go into the subway structure later.

This section of the Seventh Avenue subway is being built for the Public Service Commission, Robert Ridgway, engineer of subway construction, by the Rapid Transit Subway Construction Company.

## Three-Man Puller Removes Trench Sheeting Quickly

By H. S. CARPENTER
Cobleskill, N. Y.

THE PULLER shown in the accompanying sketch was used to extract trench sheeting at Dunellen, N. J. Made from a few feet of lumber and fittings that can be forged by any blacksmith, it weighed less than 75 lb. and was very easily handled.



PULLER WORKS RAPIDLY

Where the puller could not be set on the side of the ditch, a few planks were put across for a foundation. All that was necessary was to fit the jaw over the edge of a piece of sheeting and pump the lever. Three men were used, one to see that the jaw did not slip off the sheeting and two to pump. It was the fastest puller the writer has ever seen in operation.

# NEWS OF THE WEEK

### Passing Events in the Civil Engineering and Contracting Fields

## Charles Sooysmith, Noted Tunnel Engineer, Died June 1

**Brought Freezing Method of Excavation to This Country—Built Foundations for Many Big Bridges and Buildings**

Charles Sooysmith, prominent consulting civil engineer and contractor, died at his home in New York City June 1. He was the son of the late Gen. William Sooysmith, the eminent civil engineer, of Chicago. Charles Sooysmith was born at Buffalo, N. Y., in 1856. As a boy, on work conducted by his father, he acquired an intimate knowledge of men and of construction methods. Before he was twenty he was graduated from the civil engineering department of Rensselaer Polytechnic Institute, after which he studied abroad for two years.

In 1879 he was made assistant superintendent of the department of track, bridges and buildings of the Atchison, Topeka & Santa Fé Railway. He left that position in 1881 to join his father in the firm of Wm. Sooysmith & Son, engineers and contractors. In 1887 he organized the firm of Sooysmith & Company, contracting engineers, of which he was president. From 1887 to 1897 he constructed, among other things, the foundations of many important bridges, including those over the Mississippi River at Fort Madison and at Keithsburg, Iowa, and over the Missouri River at Kansas City and at Sibley, Mo., East Omaha, Neb., and Sioux City, Iowa. He also directed part of the building of the bridge over the Schuylkill River at Philadelphia for the Baltimore & Ohio Railroad and of the Central bridge over the Harlem River, New York City.

Among other important original work in this line Mr. Sooysmith introduced the pneumatic-caisson method of building foundations for high buildings. He was closely associated with the construction of the Manhattan Life, American Surety, Empire and Washington Life buildings in New York City.

Mr. Sooysmith also introduced into the United States and improved and developed the freezing method for making excavations. He recently perfected plans for the application of that process to the construction of subaqueous tunnels. Mr. Sooysmith's tastes were those of a student rather than of an active man of affairs and, while constantly engaged in some difficult work of the most practical nature, he was able to devote much time to the study of modern languages and literature.

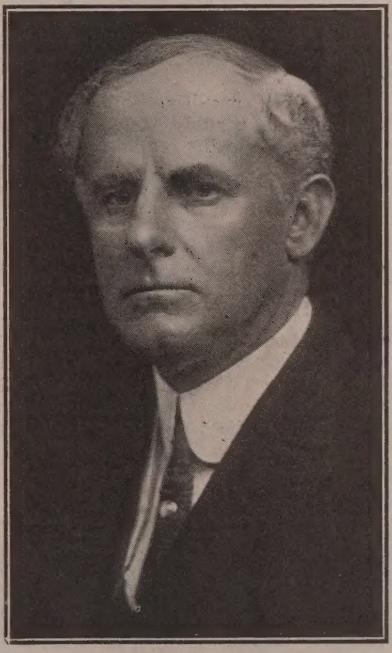
Since 1898 Mr. Sooysmith has practised consulting engineering in New York City. He was employed as an expert on New York's subway construction and was also, at one time, a member of the Metropolitan Sewerage Commission. He was a member of the American Society of Civil Engineers, of which he was a director from 1895 to 1897. He was also a member of the American Institute of Consulting Engineers and many other societies.

## Establish Massachusetts Land and Waterways Commission

Governor McCall of Massachusetts has signed an act abolishing the Board of Harbor and Land Commissioners and the Directors of the Port of Boston. In their stead a new body has been created under the title of the Massachusetts Commission on Waterways and Public Lands. All powers and duties of the old boards are to be transferred to the new one, which will consist of a chairman and two commissioners. They will serve terms of one, two and three years from July 1, 1916. Appointments are to be made by the Governor and confirmed by the council. Subsequent terms are to be of three years each. Any member may be removed by the Governor and council. The commission is to appoint and fix the salaries of a superintendent of commerce and a superintendent of engineering. An annual report is required and headquarters for the board and its staff will be in the state house.

## George D. Marshall Will Assist Texas Highway Department

Prominent Consulting Engineer and Tunnel Expert, Died June 1



CHARLES SOOYSMITH

As a step toward the perfection of the road system of Texas and a means toward construction of more durable highways, George D. Marshall, superintendent of road construction of the Office of Public Roads and Rural Engineering at Washington, has been assigned by the federal government to the highway department of Texas to act as an advisory officer. The request for the appointment of Mr. Marshall came at the instigation of Gov. James E. Ferguson.

By this arrangement a government road expert becomes available to every county in Texas desiring information as to the best system of road construction, administration and maintenance. The services of the expert to county officials is secured free of charge upon approval of the Governor. The scope of this service will also include bridge and culvert work.

An office has been assigned in the state capitol and a road exhibit is being installed which will include pictures of roads before and after improvement; road models illustrating various methods of construction and maintenance and an exhibit emphasizing the value of physical tests for road materials to determine their adaptability.

## City Planners Discuss Effect of Automobile on Street Traffic

**First Session of Eighth National Conference on City Planning in Cleveland Centers on Paper by Nelson P. Lewis**

The automobile and its effect on street traffic, and so on the city plan, was the topic for discussion at the first conference session of the Eighth National Conference on City Planning, held in Cleveland this week. There was general agreement with the views (abstracted on page 773 of this issue) presented by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York City. The main doubt expressed was whether the growing use of the passenger automobile would not increase rather than decrease the congestion in the business districts.

The conference was held in the Statler Hotel, June 5-7. Monday morning was devoted to registration and was followed by a luncheon with short talks. Following addresses of welcome at the beginning of the afternoon session Mr. Lewis read his paper, "The Automobile and the City Plan." George A. Walters presented a paper on street traffic by John H. Gillespie, commissioner of police, Detroit. He spoke of the advantages of one-way traffic on streets.

### Effect on Centralization

C. M. Talbert, director of streets and sewers, St. Louis, agreed in the main with Mr. Lewis, but thought the automobile would "discourage further centralization" only in residential and outlying districts, having the opposite effect in central and congested business districts, because of the increased facility for getting into these centers. E. P. Goodrich, consulting engineer, New York City, voiced the same opinion. He suggested as a remedy diffusion of population by the encouraging of suburban development and the laying of smooth pavements to attract autos to various routes.

W. I. Prince, mayor of Duluth, Minn., said that city had solved the problem of extra cost of handling heavy traffic by levying a wheel tax for both horse and motor vehicles proportionate to the number of horses or the horsepower. J. P. Fox, New York City, argued for better regulation of street traffic by a mechanical signal system. W. P. Blair, secretary of the National Brick Makers' Association, urged a systematic survey and the compilation of data with a view to constructing streets to conform to the traffic requirements.

At the evening session Frederick Law Olmstead, president of the conference, spoke of Cleveland's two crying city-planning needs, a coherent and complete system of radial streets and a county park system. Arnold W. Brunner also discussed Cleveland's needs. Lawson Purdy, of New York City, compared the methods of taxation of Cleveland and New York.

An account of the remainder of the conference will appear in next week's issue.

## Cement Association Changes Name and Opens New York Office

An amendment to the constitution of the Association of American Portland Cement Manufacturers was recently passed changing the name of that organization to the Portland Cement Association. The association recently opened a New York office at 101 Park Avenue, in charge of Lewis R. Ferguson.

## Boston's First Dorchester Tunnel Completed

### First of 3200-Foot Tubes Completed by Unusual Methods in Less Than Year, and Second to Be Finished by Aug. 1

Finished considerably ahead of time, the inbound tunnel of the Dorchester tubes under Fort Point Channel in Boston was connected to the finished work of the adjoining section under Summer Street in front of the South Station, June 3. The work was done in just twelve days less than one year after tunnel driving was first started on the contract. It is expected that the outbound tube will be completed by Aug. 1.

It will be remembered from the descriptions of this work on page 218 of the Engineering Record of Aug. 21, 1915, and page 136 of the issue of Jan. 29, 1916, that unusual speed was expected, due to combining light, easily-placed wood block lining and belt conveyors for handling muck from the face to cars behind the head of the concrete lining with pneumatic shield tunneling methods. The progress is said to have come up to expectations, amounting in this tunnel to more than 9 ft. per day for every elapsed day since June 15, 1915. The soil pentrated, it will be remembered from the articles referred to, is for the most part so stiff as to require considerable physical labor in its excavation. Where sandy it was found to contain boulders, which necessitated blasting.

The tunnels have been driven entirely from the construction shaft on West First Street near the southern limit of the contract, as there was no opportunity to erect a shaft plant at the Summer Street end of the work.

## Will Hear Speakers at Tech Jubilee in Thirty-Five Cities

By an arrangement of telephone connections between the Massachusetts Institute of Technology and thirty-five cities, the speakers at the institute's golden jubilee celebration this month will be heard over practically the whole United States. Each of the speakers will talk into the telephone and thousands of watch-case receivers have been provided for the audiences. Two main lines of the telephone company will be devoted to the celebration for more than two hours. Connections will be made with most of the big Eastern cities and with many of importance in the West and South.

## $2,000,000 Authorized for Roads and Bridges in Porto Rico

Bonds amounting to $2,000,000 have recently been authorized for the construction of roads and bridges in Porto Rico by the Legislature of that island. The principal and interest are to be paid from the proceeds of a special tax on all real and personal property not exempt from taxation. Various roads and bridges are specified for improvement, but the economy commission of the government is instructed to determine a plan prescribing the order of precedence in which the work will be undertaken. The construction is to be carried on simultaneously in the seven election districts of the island so far as is practical.

## Make Survey of St. Louis Smoke

The engineering department of Washington University has just completed a smoke survey of St. Louis under the direction of Prof. E. L. Ohle. The report states that the air of St. Louis, despite its smoke, is free from acidity and therefore not harmful to human life, iron or stonework; that anthracite coal may be burned in furnaces without smoke; in large furnaces bituminous coal may be burned without smoke if the overdraft is used. Use of up-to-date stoking appliances and the latest boilers is recommended.

## Minnesota Engineers Form Board for Closer Co-operation

The engineers of Minnesota, believing that through the co-operation of the various engineering societies they can be more useful to their communities, are forming the Minnesota Joint Engineering Board. The societies represented are the Northwestern Association of Members of the American Society of Civil Engineers, the Minnesota sections of the national societies of mechanical and electrical engineers, the Minnesota Surveyors' and Engineers' Society, the Engineers' Club of Minneapolis and the Civil Engineers' Society of St. Paul.

It is hoped that through the joint organization the activities of the engineers of Minnesota may be more closely correlated and more accomplished for the public welfare. George W. Pathjens, of St. Paul, is secretary of the board.

## Will Prepare Plans for New Haven Sewage-Disposal Plant

The committee on sewage disposal at New Haven has appointed a special committee to prepare preliminary plans for the proposed experiment station. The city has voted a fund for the work of the committee. Frederick L. Ford, city engineer, and Henry J. Kellogg, assistant city engineer, will assist the committee. The government will also co-operate in the undertaking and Dr. Hugh Cummings, as government representative, will help the committee.

Albert B. Hill, consulting engineer, of New Haven, has made a study of the needs of the city and reported to the committee. It is expected that the screen system and submerged outlets will be adopted. Work may be started in about two years.

## Motor Trucks Demonstrate Ability to Turn in Narrow Limits

The motor truck is effectively demonstrating its ability to turn in narrow limits in the building of the Twin Peaks tunnel in San Francisco. The accompanying illustration shows a 5-ton White truck being loaded and gives an idea of the difficulties presented in reaching the point of charging.

## Engineer Investigates Floods in Northern Minnesota

Prof. Adolph F. Meyer, of the College of Engineering, University of Minnesota, and consulting engineer for the International Joint Commission, has just returned from the northern part of Minnesota, where he was called to investigate flood conditions on the Lake of the Woods watershed. Damage from high water has been serious and the waters are still rising. Professor Meyer stated that if such regulation of these waters as the International Joint Commission will soon recommend to the governments of the United States and Canada had been in force, most, if not all, of the damage could have been prevented.

### Postpone Ohio Conservancy Hearing

A majority of the members of the Miami Conservancy Court, at the May 31 meeting, voted to postpone the hearing from June 19 to Oct. 3. Objections to the official plan for flood prevention will be presented at that time.

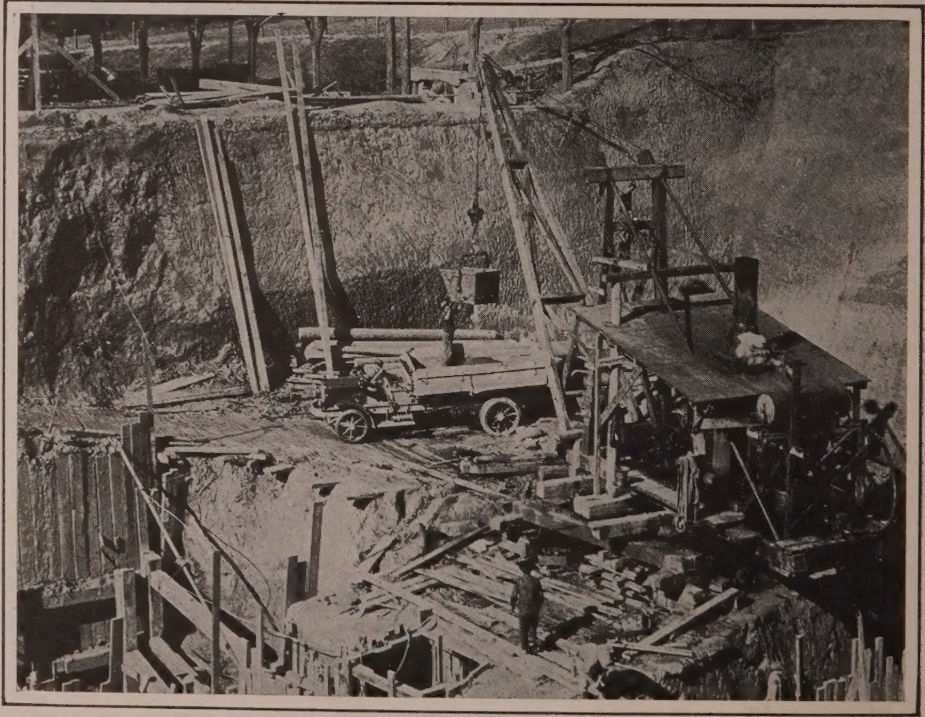
### Public Utilities Association Will Hold Convention July 12

The Public Utilities Association of West Virginia will hold its convention at the Chancellor Hotel, Parkersburg, W. Va., July 12 to 14. Representatives of electric light, power, traction and water companies of that state will attend.

## Engineering Society Activities

**The Engineers of Charleston**, S. C., are forming an engineering society in that city. The second meeting was held June 5 in the Chamber of Commerce Building. Thirty engineers attended the first meeting, which was in May.

**The Engineers' Society of Western Pennsylvania**, at the May 31 meeting, heard A. L. Humphrey, vice-president and general manager of the Westinghouse Airbrake Company, deliver the last of a series of free lectures on military engineering. Mr. Humphrey's address



TRUCKS MUST BE EASILY HANDLED TO REACH POINT OF CHARGING was on the mobilization of materials and industrial resources. An unusually large audience was on hand.

**The Edmonton Branch of the Canadian Society of Civil Engineers** recently elected L. B. Elliot chairman and C. A. Robb secretary and treasurer.

**The Engineers' Club of Baltimore** has elected the following new officers: Alfred H. Hartman, president; Henry G. Shirley, vice-president; William D. Janney, secretary-treasurer. Thomas D. Pitts, Edward F. Ruggles and Richard K. Meade were made directors for the next two years.

**The Technical Society of Waterloo, Iowa,** is working to secure a rigid building code for that city. The society was organized last September and the present membership includes fifty engineers and contractors. Meetings are held the last Friday of each month.

**Los Angeles members** of five national technical societies held the second annual joint meeting in that city June 1. All topics on the program were allied with preparedness. Dean George A. Damon of Throop College of Technology served as toastmaster and introduced a number of noted engineers, each of whom briefly discussed some phase of the subject or suggested how engineers could participate in the movement. A unanimous vote was cast authorizing the forwarding to the U. S. Senate and House of Representatives of resolutions expressing a desire for preparedness.

**The Engineers' Club of Seattle,** at the regular weekly meeting June 1, heard C. E. Bogardus, assayer, chemist, testing and inspecting engineer, of Seattle, speak on "Salted Mines."

**The National Lumber Manufacturers' Association** held its annual meeting in Chicago May 31 and June 1. Most of the addresses referred to purely business problems, such as trade extension, advertising and selling. Of special interest to engineers were papers by Frank D. Chase, consulting engineer, Chicago, on "Why Architects and Engineers Want Branded Timber," and by Dr. Hermann von Schrenk on "Tests of Fire-Resistant Paints."

**The Colorado Association of Members of the American Society of Engineers** was addressed June 10 by J. B. Lippincott, consulting engineer, of Los Angeles, on "The Construction and Operation of the Los Angeles Aqueduct." L. R. Hinman, the secretary, stated that the regular meetings during July and August will be omitted, but the Wednesday luncheon will be continued.

**The Western Society of Engineers** was addressed June 5 by J. L. Jacobs, consulting engineer, of Chicago, on "Public Service Opportunity and Preparedness."

## What Engineers and Contractors Are Doing

FRANK S. HARRIS has been appointed efficiency engineer of the Oakland (Cal.) municipal government by the Oakland civil service board, succeeding W. P. Smith, resigned. Mr. Harris was formerly in the office of Galloway & Markwart, consulting engineers, of San Francisco. He was also connected with the engineering department of the Panama-Pacific International Exposition.

WILLIAM E. IRVING, of the engineering department of the Pennsylvania Railroad, has been transferred to Parnassus, Pa., to work on the construction of a branch line of that road in Westmoreland County.

ALFRED C. GREGORY, engineer of sewers and water of Trenton, N. J., has been appointed chief aid for Mercer County in carrying out the program of industrial preparedness outlined by the Naval Consulting Board of the United States.

W. H. SCALES was recently made chief engineer and secretary of the Blackhawk Construction Company, of Waterloo, Iowa.

FRED GONYOU, chief engineer of the Dominion Sugar Company, has been sent to Chatham, Ont., where a new million dollar plant is being erected by his company.

CHARLES PRATT has resigned as city engineer of Chanute, Kan., to take a similar position at Erie, Kan.

G. N. WOOD, formerly in the engineering department of Douglas, Ariz., has been made city engineer of Chanute, Kan.

C. J. DONALDSON, whose appointment as county surveyor for Montrail County, North Dakota, was noted in the Engineering Record of May 22, 1915, has resigned to become associated with Swearingen & McCulloh, consulting engineers, of Great Falls, Mont. Mr. Donaldson has had nearly twelve years' experience in municipal engineering. The firm with which he now becomes associated specializes in the design of municipal utilities.

B. L. FIELD, assistant superintendent for Robert G. Lassiter & Company, engineers and contractors, of Oxford, N. C., has been transferred to Wilson, N. C., to start work on a paving job of 100,000 sq. yd. in that city.

FRANK C. SMITH is now employed by the engineering department of the Central of Georgia Railway at Savannah, Ga. He was previously engaged in general engineering work in Florida.

A. N. JOHNSON, for many years Illinois state highway engineer and now consulting highway engineer for the Portland Cement Association, has been appointed chairman of a subcommittee of Committee D-4 of the American Society for Testing Materials to investigate and report on tests for concrete aggregates in concrete roads. Mr. Johnson's committee will make its first report at the Atlantic City meeting of the American Society for Testing Materials, June 29.

NEIL MCDONALD, general contractor, of Seattle, has removed his office to larger quarters in the Joshua Green Building.

J. M. SUTTON, foreman for the Foundation Company, has been transferred to Wellsburg, W. Va., to take charge of placing reinforcing for a steam power plant being built for the American Gas & Electric Company. Mr. Sutton has been foreman for the Foundation Company on jobs in Washington, British Columbia, Michigan, Missouri and New York.

RICHARD LAMB, consulting engineer, of New York City, has removed his offices to 90 West Street.

G. J. REQUARDT, whose appointment as head of the department of franchises and privileges of Baltimore was noted in last week's issue, has resigned to become connected with Norton Bird and Whitman, engineers, of Chicago and Baltimore. Mr. Requardt is at present located in the Baltimore office.

EDGAR E. CALVIN was elected president of the Union Pacific Railroad May 31. He was previously vice-president and general manager of the Oregon Short Line.

C. R. BUDD, of Gloucester County, New Jersey, has been made a member of the Delaware River Bridge and Tunnel Commission, succeeding the late Elwood Usinger.

W. H. KNAUS has resigned as engineer for the Alton-Slater Water Company, of Slater, Mo., to become engineer for the Anderson Land Company, of Cedar Rapids, Iowa.

E. WILLIAM KOHL, JR., has resigned as chief engineer of the Spanish-American Iron Company to open an office as consulting engineer and contractor at Central Borjita, Dos Caminos, Oriente, Cuba. He held his recent position for seven years. Mr. Kohl began engineering work with the Philadelphia & Reading Railway in 1902. He assisted in the installation of a sewer system in the borough of Norristown in 1905 and 1906, after which he entered the engineering department of the Pennsylvania Railroad. He became connected with the Spanish-American Iron Company in 1909 at Daiquire, Cuba.

BARTLETT & RANNEY, consulting engineers, of San Antonio and Dallas, Tex., have been engaged by the city of Austin to inspect the Austin dam on the Colorado River. It was rebuilt and recently completed by the contractors when a controversy arose over certain changes in the plans and methods of construction. A comparison will be made of the structure as it now is with the original design.

PELLISSIER & DIBBLE, engineers and architects, of Springfield, Mass., have removed their offices to the Third National Bank Building.

J. W. ELLMS, consulting engineer, of Cincinnati, has been retained by the city of Cleveland to take charge of its Division Avenue filter plant, which is expected to be in operation July 1.

JOHN E. GEORGE has been appointed assistant to Frank H. Zouck, chairman of the Maryland Road Commission.

J. WIGHTMAN CLEAVELAND, formerly assistant engineer of the sewerage commission of Baltimore, has resigned to become supervisor for the E. I. du Pont de Nemours Powder Company.

CALVIN W. HENDRICK, city engineer of Baltimore, has been made chairman of a commission to revise the building code of that city.

ERNEST WILLIAM MOIR, director of S. Pearson & Son, Ltd., of London, and representative of the British Ministry of Munitions in the United States, was recently made a baronet. Mr. Moir is an engineer of world-wide repute. He studied at the West of Scotland Technical College and at University College, London, England, after which he joined the staff of Sir William Arroll on the construction of Forth bridge. He had charge of the caisson work, using caissons over 70 ft. in diameter. He superintended the driving of the Hudson tunnel at New York in 1888, but the work was stopped after 2000 ft. had been completed. In 1891 he was engaged by S. Pearson & Son, Ltd., to construct the Blackwell tunnel. Since then he has completed the national harbor works at Dover costing more than $20,000,000; constructed the largest tube railroad in London for the Great Northern & City Railway and completed the East River Tunnel at New York City for the Pennsylvania Railroad. Mr. Moir has been a director of S. Pearson, Ltd., since 1899.

## Obituary Notes

ELWOOD USINGER, member of the Gloucester County (N. J.) Board of Freeholders and one of the leading road and bridge builders of New Jersey, died May 31 at the age of 68. He was a member of the Delaware River Bridge and Tunnel Commission.

ARMORY COFFIN, consulting engineer, of Phoenixville, Pa., died at his home in that city June 5 at the age of 75. Mr. Coffin was connected with the design and construction of many important buildings and was for many years chief engineer of the Phoenixville Iron Company. He also served in the Civil War. His membership in the American Society of Civil Engineers dated back to 1875.

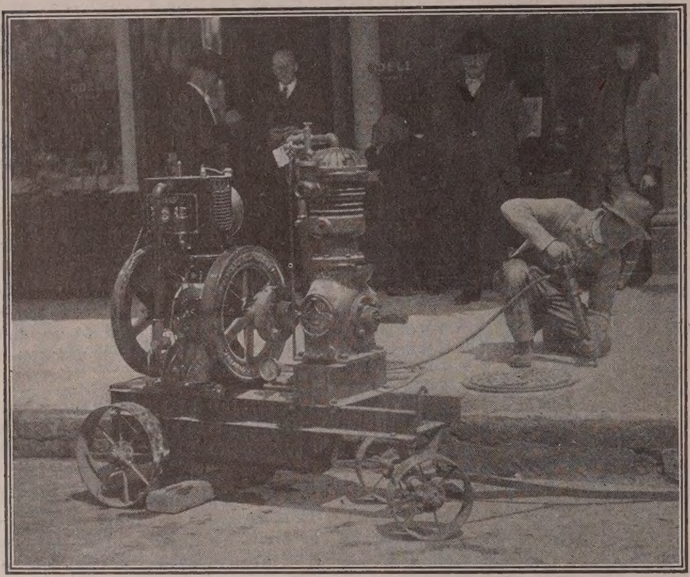
FREDERICK SEWALL BROWN, railroad contractor and engineer, died May 31 at Evanston, Ill., at the age of 62. He was born in Bangor, Me., and had been engaged in the contracting business for twenty-eight years. He was a member of the Western Society of Engineers.

## New Stone-Roughing Outfit Perfected by Illinois Company

The Gardner Governor Company, of Quincy, Ill., offers to engineers and contractors the first outfit ever constructed for roughing stone. It has been tested by the Brinkoetter Monumental Company, of Quincy, and the first machine is said to have operated successfully in that city and vicinity.

The outfit consists of an air-cooled air compressor driven by a gasoline engine mounted on a light steel truck. An air receiver is held under the truck. The compressor is a Gardner-Rix vertical, air cooled, oil-splash lubricated machine connected to the engine by a coupling. The compressor valves are of thin flexible sheet steel and cannot be drawn into the cylinder.

The tool is an ordinary plug drill fitted with a case-hardened steel block with sixteen sharpened raised points. The block has a wire handle which helps to guide the tool. In chipping around cracks and posts set into the sidewalk a trimming tool is used. An unloading device regulates the air pressure for the most efficient work.



NEW PORTABLE MACHINE FOR ROUGHING STONE IS OPERATED BY AIR COMPRESSOR DRIVEN BY GASOLINE ENGINE

## Ring Around Piles Repels Borers

A device was recently put on the market in California to protect piles from marine borers. Constant friction and blows are given the pile by a metal ring suspended 16 in. below the surface of the water and surrounding the pile. The ring fits the pile loosely and is raised and lowered automatically by blocks of wood which are secured to the ring by chains. Waves and the tide raise and lower the ring and revolve the floats constantly, rubbing against and delivering sharp blows on the side of the pile. Borers enter or attack the pile from the exterior about 2 ft. below low tide up to the high-tide line. After attachment they take several days to enter. To live they must maintain their connection with the original point of entrance.

The idea of the device is that blows of the floats and rings will kill the animal by force and injure the siphons maintained at the surface. The inventor, Alva L. Reynolds, who controls it, asserts that his protector will prevent attacks on new piles, save the sound portions of old piling and clean piling of any type of marine life, barnacles, mussels, moss or seaweed. Six hundred piles supporting Neptune Pier, at Long Beach, under observation for sixteen months for abrasion, are said to have shown no attacks and no appreciable wear.

The device is controlled by the Common Sense Pile Protector Company, Long Beach, Cal. Protection service per year, and not the device, is sold.

## Pipe Company Leases Big Mills at Columbia, Pa.

The A. M. Byers Company, of Pittsburgh, has leased the plant of the Susquehanna Iron Company, at Columbia, Pa. The works consist of the Columbia and the Susquehanna plant. The Susquehanna works consist of a puddle mill with thirty-two single furnaces and equipment of squeezers and muck bar mill. It will make puddled iron for the Columbia mill. The pipe mill at Columbia contains one buttweld and one lapweld furnace.

D. F. Manice of the Pittsburgh mills has been appointed manager of the Columbia works; L. M. Johnston will be general manager. At the South Side mills the company is adding a 750-kw. turbo generator unit furnished by the Kerr Turbine Company, of Wellsville, N. Y.

## New Construction Eliminates Broken Sidewalk Lights

By setting square sidewalk lights in a metal holder with waterproof expanding material and embedding the holder in cement, breakage due to unequal expansion of glass and conduit is reduced to a minimum. Steel V-shaped angles placed with the point down support the holders and shut off a minimum amount of light. Another advantage claimed is the ease of replacements, as no chipping of the cement is necessary. The lights are made by the Bayley Structural Iron Company, of Milwaukee.

### Introduce Imported Tracing Cloth

A new brand of imported tracing cloth has recently been put on the market by the Defiance Manufacturing Company, of New York City. Its transparent and erasing qualities are said to have exceptional merit. The brand is known as Stirling. Branch offices of the Defiance company are in Boston, Philadelphia and Chicago.

## Chicago Steel Company Buys Plant at New Castle, Del.

The American Manganese Steel Company, of Chicago, has purchased the plant of the Brylgon Steel Casting Company, at New Castle, Del., having a monthly capacity of approximately 400 tons of steel castings. The company now has two plants at New Castle and one at Chicago Heights, Ill. The newly acquired plant is rapidly being converted into a manganese steel foundry of the latest and most efficient type. Actual production is expected to start July 15.

## Business Notes

**The Traylor Engineering & Manufacturing Company**, of Allentown, Pa., has acquired control of the Cement Gun Company and elected officers as follows: President, S. W. Traylor; vice-president, W. J. Roberts; secretary, F. R. Crispen; treasurer, H. Battersby; general manager, B. C. Collier.

**Edward T. Terry** has formed the Edward T. Terry Manufacturing Company, Grand Central Terminal, New York City, to carry on the business of manufacturing cranes, derricks and structural steel formerly handled by the Terry & Tench Company, Inc. The business of the Terry & Tench Company, with the exception of the above departments, will be carried on as usual and the offices of both companies will be continued at the address given.

## Trade Publications

The following companies have recently issued trade literature:

**John A. Roebling's Sons Company**, Trenton, N. J. A new 9½ x 6½ in., 16-page publication for users of wire rope.

**Wallace & Tiernan Company, Inc.**, New York. Booklet 8½ x 4 in., 11 pages, "The Cost—Hypochlorite vs. Liquid Chlorine."

**Ingersoll-Rand Company**, New York. Booklet 9 x 6 in., 44 pages, illustrated. Construction and advantages of Leyner-Ingersoll water drills.

**Municipal Engineering & Contracting Company**, Chicago. Catalog, 8 x 9 in., 32 pages, illustrated. Austin cube concrete mixer is described and use illustrated.

**Heltzel Steel Form & Iron Works**, Warren, Ohio. Two booklets, 11 x 8 in., 14 pages, illustrated. One on steel road forms, the other on steel curb and gutter forms.

**American Abrasive Metals Company**, New York City. Booklets describing uses of "Feralun" insert strips for stairways and sidewalks to prevent slipping of pedestrians.

**Zelnicker Supply Company**, St. Louis, catalog, 8½ x 3¾ in., 10 pages. A list of special bargains in second-hand equipment for contractors.

**Biehl Iron Works**, Reading, Pa. Catalog F, 9 x 6 in., 48 pages, illustrated. Contractors' equipment. Contains several tables and is accompanied by circular describing this company's improved car loader.

**Osgood Company**, Marion, Ohio. Circular 14, 8½ x 11 in., 12 pages, illustrated. Describes the "Osgood 18" ¾-yd. traction steam shovel for sewer-trench excavating. Contains several cross-sections.

**Turner Construction Company**, New York. Booklet, 8½ x 11 in., 14 pages, illustrated. Contains photographs of buildings erected by this company and outlines its policy in handling contracts.

**National Transit Pump & Machine Company**, Oil City, Pa. "Transit" bulletin 302, 9 x 6 in., 16 pages, illustrated. Shows improvements effected in this company's new vertical triplex, single-acting power pumps.

**Trussed Concrete Steel Company**, Youngstown, Ohio. Booklet, "Kahn Pressed Steel Construction," 8½ x 11 in.; 23 pages; illustrated. Fire-resistive floor construction by use of pressed-steel beams, Hy-Rib, pressed-steel joists with either reinforced-concrete beams or steel I-beams is fully illustrated, with tables for safe loads and general specifications.

**National Tube Company**, Pittsburgh, Pa. Bulletin 5, 8½ x 11 in., 88 pages, illustrated. Specifications and useful tables. Mechanical properties of solid and tubular beams, safety factors and safe working fiber stresses, flow of streams and synopsis of contents. Numerous photographs of buildings in all parts of the country in which National pipe has been installed.